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YUMA PROVING GROUND AZ
DESERT TESTING ENVIRONMENTAL BIBLIOGRAPHY.(U)
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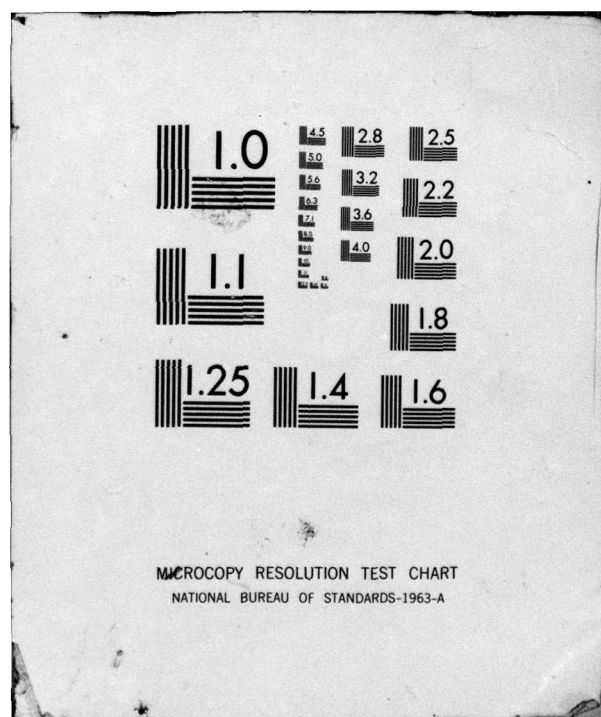
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)		
The bibliography includes over 900 abstracts of publications presenting information on environmental factors that influence the design and conduct of desert field tests and related environmental assessments. Coverage scope extends to the world deserts but emphasis is on that portion of the Sonoran Desert in Arizona occupied by the US Army Yuma Proving Ground. The bibliography includes extensive author and subject indices.		

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FOREWARD

Materiel testing has been conducted at Yuma Proving Ground (formerly Yuma Test Station) since World War II. The Yuma Proving Ground, as the Army's desert test center, is continuously collecting knowledge of environmental effects on the survivability, performance, and maintainability of all types of materiel in the desert. Future testing will contribute to broadening that base. Information tailored specifically to a particular test, location, or materiel can be obtained from the published reports or from the Proving Ground.

The compilation and publication of this bibliography represents the effort of many individuals and organizations. In particular, recognition should be extended to Edward Uhl, deceased, who provided many of the documents covering work done in the 50's, and the contributions of John Rezin, who not only assisted in the collection and preliminary indexing, but also arranged for the survey by the Library of Congress. The survey by the Library of Congress was comprehensive, and particularly valuable in providing world coverage through the 60's. Mr. Thomas McIntire provided the software for supporting the tedious preparation of the index which was loaded by Miss Rebecca Seibert. Typing of the final copy of the abstracts was performed by Miss Teresa Paris.

It is believed that this report provides a significant step towards meeting the goal of providing information that will assist the RDTE Community to reach a better understanding of the desert, its effects on man and materiel, as well as their effect on the desert.

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WAHNER E. BROOKS
Chief, Methodology and
Instrumentation Division

I N T R O D U C T I O N

The bibliography is presented in two parts. The first part contains abstracts of various publications about the desert environment, with emphasis on that part of the Sonoran Desert including the US Army's Yuma Proving Ground. The second part contains subject and author indices to the abstracts.

The bibliography began in 1967 as a personal card file supporting the development of procedures for desert testing of various classes of material. Emphasis was on climalogical and geophysical factors affecting equipment survivability. As the procedures were implemented, the card file acquired more regional information to support the design of testing facilities and courses.

In order to improve testing validity, more data on the world's deserts was sought. A contract with the Library of Congress resulted in a separate card file of some 800 items. As the two files were merged, many items were dropped due to duplication, obsolescence or inappropriateness. Nevertheless the combined file included over 1200 items.

Up to this point, the file was used by a small staff familiar with its contents and intimately involved in its frequent reshuffling. As the Army's environmental quality program was implemented, and other agencies began work in desert operational analyses, the file became inadequate to support the many users involved in these new efforts.

To meet information dissemination needs, and protect the integrity of the data base, the preparation of this bibliography was begun. Over nine hundred items are included, including several dozen entered during the assembly stage. Items were not included for the following reasons:

- a. Redundency (i.e. replaced by a later edition or included in a more complete or available publication).
- b. Applicability (i.e. too general in treatment or lacking pertinence to the Proving Ground missions).
- c. Inavailability (i.e. the abstract was ambiguous or generalized and the source document could not be found).

While several authors or documents have been adversely criticized by others, they have been included in the bibliography unless blatantly misleading and lacking even historical value. This listing does not pretend to be a critical review.

The bibliography does not include test plans, reports, procedures or memoranda prepared by the staff of Yuma Proving Ground (or its predecessor, Yuma Test Station). These documents may be covered in a separate bibliography which is still in the planning stage.

The existence and form of further changes or additions to this bibliography is dependant on interest and need, the availability of funding and personnel, and the state of text processing/distributing technology. It is probable that the data base will be transferred to a computer which will be accessible through the Defense Communication Agency ARPANET or some similar system. Current ARPANET users can transmit inquiries to: WBROOKS at SRI-KA. Off net users should write to: COMMANDING OFFICER, US Army Yuma Proving Ground, ATTN: STEYP-MMI, Yuma, Arizona 85364.

Documents cited can not be provided by Yuma Proving Ground. Many are not here, but were borrowed or utilized at other locations. Many are in private collections and not accessible. Users should contact their organizational reference librarian or information center. DDC and LC accession numbers are provided where known.

ABSTRACTS

Author and subject indices to the following abstracts are included at the end of this section. Copies or extracts of the cited documents should be requested from the indicated sources. US Army Yuma Proving Ground can not provide many of the documents cited (see the introduction).

1. Simons, Hilah L. THE GEOLOGY OF THE CABEZA PRIETA GAME RANGE
Arizona Geological Society Digest 8:147-57, incl. illu.,
1966. DLC, unbound.

The Cabeza Prieta Game Range, located in Yuma and Pima Counties, Arizona, encompasses nearly 1,400 square miles of low mountain ranges separated by a wide alluvial valley, with elevations varying from 600 to 3,323 feet above sea level. The two types of mountains are sierras and mesa. With the exception of two areas, the valley is drained by ephemeral streams which finally drain into the Gulf of California.

2. Younger, F.O., W.G. HARPER, et al 1928 SOIL SURVEY OF THE
GILA BEND AREA, ARIZONA US Department of Agriculture
Series 1928, number 4, 22 pp.

The Gila Bend Area, in the southwest part of Arizona, includes 224 square miles lying along the Gila River. Five series of soils were mapped in the area. The more mature soils are grouped in the Laveen, Mohave, and Pinal series and the recent alluvial soils in the Gila and Pima series. The miscellaneous non-ag materials are river wash, rough strong land, and seab land. The most important ag soils are laveen sandy loam and fine sandy loam. Slight too strong alkali concentrations are found in both the Gila and Pima soils.

3. Kearney, Thomas H., Robert H. Peebles, et al ARIZONA FLORA
2d edition with supplement by John Howell and Elizabeth
McClintock. 3rd printing, 1969. Berkeley, University of
California Press, 1960, 1085 p., incl. illus., map gloss-
ary, 371 refs. DLC, QK147.K38 1960.

Replaces authors' "Flowering Plants and Ferns of Arizona," issued in 1942 as MISCELLANEOUS PUBLICATION NO. 423 OF THE U.S. DEPARTMENT OF AGRICULTURE. Since 1942 the known flora of Arizona has been increased by 1 family, 32 genera, and 190 species. The collaborators toward the present work number 23. Keys are given to all spp., at times rather fully descriptive. Ranges are summarized, for rarer plants with citation of specimens. Part I (of 11 pages) treats the Physical Background and Vegetation of Arizona, and the first pages of Part II, show 45 photographs of vegetation and of individual spp.

There is a brief summary of Geographic Elements of the Flora. Next Pteridophyta and the Spermatophyta are considered. In the supplement, one family, 19 genera and 68 species are added. The present known flora of Arizona numbers 3,483 species.

4. Uhl, Edward L. Jr. ROAD CONSTRUCTION TECHNIQUES FOR DESERT AREAS Corps of Engineers Climatic Field Test Team, Yuma Test Station, Yuma Arizona 30 April 1953 (typescript) 141 pp. 85.71

Although the report is directed towards the evaluation of military road construction equipment and technique in the desert areas, it contains considerable valuable information. Terrain types in the USAYPG area include hummocky sand plains, sand dunes, dry lake bed, dry river bed, wash channel, sand plain and desert pavement. Each site has supporting photography, description (including vegetation), and soil characteristics (including mechanical analysis, devices, and CBR's.)

5. Rahn, Perry H. SHEETFLOODS AND STREAMFLOODS, AND THE FORMATION OF PEDIMENTS Annals, Association of American Geographics v.57 no.3 September 1967 pp. 593-604 16 illu., 2 tables, 11 ref.

Field observation of flash floods in the desert plains of southwestern Arizona indicate that such floods have the following two characteristics: 1) floods on pediments occur as streamfloods. Sheetfloods are limited to the bahadas. 2) Streamfloods on pediments exhibit supercritical flow. Three of the floods were in the vicinity of Aguila; on Joshua Tree State Monument, in the Harguahala Valley and in the Harguahala Mountains, during August 1963.

6. Meyers, J. Stuart EVAPORATION FROM THE 17 WESTERN STATES Geological Survey Professional Paper 272-D, US Government Printing Office, Washington DC, 1962 100 pp., 55 fig., 9 tables, 1 map, 15 ref.

A study of evaporation from reservoirs, lakes ponds, etc., with the closest area Lake Havasu (Parker Dam). Map of the US (1:7,000,000) indicates USAYPG rate. of 77 inches (eastern portion) to 86 inches per year (western portion).

7. Schafer, Howard C. TEMPERATURE PROFILES OF RAIL TRANSPORTED ORDNANCE, Part 1 Desert Environment. China Lake, California: Naval Weapons Center, April 1978. 78 pp. (NWC TP 4917, Part 1, publication UNCLASSIFIED).

Describes conditions experienced by ordnance-carrying rail stock in extreme desert environments during the period 1970 through 1977. Results of temperature measurements are given, and cumulative probability figures that are usable in predicting temperatures that are likely to be experienced by ordnance-loaded boxcars and flatcars are presented.

8. Simpson, Maurice H. SYSTEMS APPROACH TO SOLVING ENVIRONMENTAL ENGINEERING PROBLEMS. Institute of Environmental Sciences 1969 Proceedings -- (Theme: 15th Annual Tech. Mfg. "Man In His Environment" April 20-24, 1969) Anaheim, CA. pp. 490-95.

A system engineering approach provides a model developed that is devoid of arbitrary factors; thereby it is realistic to natural environments of field and storage (standby) operations. System concepts are used to encompass the effects of multi-environmental complexes. Criteria developed by this method are appropriately precise and accurate for likelihood, margin for error, and calculation of risk (uncertainty).

9. Buol, S.W. SOILS OF ARIZONA, Technical Bulletin 171, Arizona Agriculture Experiment Station. 1966 25 pp.

Included is a soil association map which indicates the distribution of soils in the state. Each mapping unit is described briefly in general terms. No attempt made to give detailed profile descriptions of the soils present. Characteristic series in each unit are named and their placement in the new classification system is given to inform the professional reader of the characteristics of the soils in the unit. (AZ-97)

10. Nichol, A.A. 1952 THE NATURAL VEGETATION OF ARIZONA
University of Arizona, Tech. Bull., no. 127 22 photos

Natural vegetation is broken down into 3 main groups; Desert, 42% of the state, Grassland, 25%, and Forest, 33%. The desert type vegetation is predominate in the western and southern portions of the state. Grasslands occur mostly in the southeastern and northeastern parts where they border forestlands which are predominant in a northwest to east belt in central and eastern Arizona. Discussion is concerned primarily with the distribution of vegetation and vegetation types rather than density. Using this paper as a basis for mapping is possible since a more detailed map can be derived from it by utilizing specific references, photos and other publications, plus personal observation. Photographs helpful for vegetation density and type.

11. Nichol, A.A. 1937 THE NATURAL VEGETATION OF ARIZONA: Arizona Agricultural Experimental Station Tech. Bull., no. 68 pp. 181-222

Very small scale map showing vegetation distribution in Arizona. A vegetal breakdown by elevations, temperature, and rainfall is provided. The relationship of the Creosote-Burrow Bush Zone, the Giant Cacti, the Pinyon-Juniper Belt, the Corifers of higher elevations, and grasses are all investigated. Many good photographs are provided. Types of plants are discussed separately and in the regions in which they commonly are found.

12. Robinson, T.W. 1958 PHREATOPHYTES: US GEOLOGICAL SURVEY
WATER-SUPPLY Paper no. 1423, 84 pp.

Survey of the phreatophytes (water-loving) plants of the arid and semiarid regions of US including distribution and nature of the common phreatophytes (saltcedar, mesquite, baccharis, greasewood, willow, cottonwood, and saltgrass). On pp. 32-40 he has a table entitled "Phreatophytes in Western United States" which he lists the common and scientific names of the common phreatophytes, the depth to water table below land surface, water quality tolerance, and their use in acre feet per acre of ground water. Most important the general occurrence as a phreatophyte in the desert areas is listed. 4 page bib. with 32 photos.

13. Peebles and Kearney ARIZONA FLORA Bound Report, Methodology and Instrumentation Library.

Short mimeographed report gives an overview of the topography, geology, soils, and climate of Arizona. Not detailed but informative.

14. Thrower, N.J.W. LAND USE IN THE SOUTHWESTERN UNITED STATES FROM GEMINI AND APOLLO IMAGERY, Annals, Association of American Geographers, 60 (1): pp. 208-09 and map supplement 12, 1970.

Gemini and Apollo satellite photography of the area, including dry deserts of California eastward into Texas, is superior in quality to that of any major region of the US, exhibiting a directory of land use characterized by aridity. . . . The land we map under review is a scale of 1:1,000,000. It delineates cropland, hard rock mining surfaces, grazing land, woodland and coniferous forests, airfields and ground transportation linkages, settlements, bodies of water, and the predominant land type of the area . . . desert. (AZ-525)

15. Altman, P.L., and D.S. Dittmer eds. ENVIRONMENTAL BIOLOGY, FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY, Bethesda, Maryland, 1966 (694 pp., BA(48) 37059)

This handbook presents quantitative and qualitative data on effects of environmental factors on man, other animals, and plants, specifically compiled for reference purposes. (A1-33)

16. Stone, R.O. A DESERT GLOSSARY, Earth Science Reviews 3 (4) 1967 pp. 211-68

A compilation of current terms. Entries are largely physiographic and geologic, but botanical, pedological, (and) climatological terms are included. The deserts of the United States and Mexico are covered in detail with supplementary terminology for other deserts. (A1-966)

17. Beebe, B.F. AMERICAN DESERT ANIMALS, David McKay Co. Inc., New York, 1966 (181 pp. BA (48) 36533)

Javelinas, prairie dogs, 'ringtails', pack rats, and bighorn sheep are included. Environment, food and breeding habits, sociability and other items are discussed. Bibliography and subject index incl. (A1-120)

18. Gordon, James H. MIRAGES Smithsonian Institution Annual Report, 1959, Publication 4392, US Government Printing Office, Washington: 1960 pp. 327-46

General discussion of mirages with attempts to explain the various types. Emphasis is on author's observations in the vicinity of Yuma, Arizona. (no. ref.)

19. McDonald, James E. CLOUDINESS OVER THE SOUTHWESTERN UNITED STATES AND ITS RELATION TO ASTRONOMICAL OBSERVING Arizona University Inst. Atmos. Phys., Scient. rpt. no.7 Feb. 24, 1958 68 pp. incl. illus., tables. AD 158 726

A number of types of cloudiness statistics for Weather Bureau Stations in SW United States were analyzed in terms of their implications for astronomical observatory site-location. Analysis indicated that during the winter half-year, the area extending out about 200 mi. northeast and east of Yuma is the best portion of Arizona for observation sites. Sites in this area will have clearer winter skies than those over coastal southern California, and be somewhat superior to those north of the Mogollon Rim. (LC-513)

20. Clements, F.E. THE ORIGIN OF THE DESERT CLIMAX AND CLIMATE In: Essays in geobotany in honor of William Albert Setchell, ed. by T.H. Goodspeed Berkeley, University of California Press, 1936 pp. 87-140 DLC, QK101.E8

A desert climax is marked by the absence of forest, grassland, a critical deficit in rainfall, and high potential evaporation caused by excessive heat and high winds also. In applying test to the vegetation of North America, it becomes clear that the term desert is often loosely employed by ecologist and geographer alike. The most effective test is afforded by tracing the boundary of the grassland climax in the Southwest. This is correlated with rainfall or better still, rainfall/evaporation where this is possible, to provide the best delimitation of desert availability today. In general, the isohyet of 5 inches marks the disappearance of grass dominants on the climax level, and thus is the readiest means of setting off the desert climax. It will suffice to state that the desert, as characterized by Larrea, Franseria, and their typical associates, is confined to the Death Valley, Mohave, and Colorado regions and to a larger but less known area in Mexico. (LC-634)

21. Green, Christine R. SEASONAL PRECIPITATION AND TEMPERATURE DATA FOR SELECTED ARIZONA STATIONS Arizona University Inst. Atmos. Phys., Tech. rpts. meteorol. and climatol. of arid regions no. 12 42 pp. incl. graphs, tables, refs. July 15, 1964 DLC QC993.7.T4

Annual tabulations of winter (November thru April) and summer (may thru October) precipitation and temperature for 23 Arizona weather stations have been analyzed. Their relationships are shown and discussed briefly. Weather stations located in the Sonoran Desert include: Yuma Citrus Station, Dateland, Mohawk, Buckeye, Phoenix, Tempe, Mesa Exptl. Farm, Gila Bend, Maricopa, Sacaton, Florence, Casa Grande and Ajo. (LC-700)

22. Barbour, Michael G. AGE AND SPACE DISTRIBUTION OF THE DESERT SHRUB LARREA DIVARTICATA Ecology, v.50, no.4: pp. 679-85 incl. tables, refs., 1969. DLC QH540.E3

Field observations of *Larrea divaricata* Cav. throughout its United States range were used to determine: 1) the age distribution of stand members, 2) the spatial distribution of stand members, and 3) the magnitude of certain soil changes across abrupt community boundaries. Significant non-central tendencies in age distribution of most stands indicated that germination and survival are rare events, contributing to one-age or several-age stands. shrubs were distributed at random, in clumps, or at regular intervals depending on the environment. Soil pH and salinity changes across ecotones were neither predictable nor usually great enough to affect germination and early growth of *Larrea*. (LC-792)

23. Jaeger, Edmund C. THE NORTH AMERICAN DESERTS Palo Alto, California, Stanford University Press; London, Oxford University Press, 1957, 308 pp. DLC QH88.J3 (re-printed 1967)

Popular presentation in which deserts of North America are discussed. Chapters included on the Chihuahuan, Sonoran, Vizcaino-Magdalena Desert of Baja California, Yuman Desert, Desert Plains and Foothills of Sonora, and the Gulf Desert (western and eastern sides of Gulf of California). Flora and fauna emphasized but also included are brief discussions of the physiography and geology, climatic data, several maps in which the various deserts are outlined, and a brief bibliography. Good line drawings various common vegetation types.

24. Sutton, Ann and Sutton, Myron LIFE OF THE DESERT part of Our Living World of Nature series, (LC 66-17516; 15 BN 07-046002-7), McGraw-Hill, Inc., New York 1966 232 pp.

A popular introduction to deserts, with emphasis on the North American Deserts. Includes sections on ecology, the influence of man, desert animals and vegetation, climate, land forms, and adaptation. Appendices are included on endangered animals, poisonous animals, and lizards.

25. Dingman, Ross Evan VARIATION IN SELECTED POPULATIONS OF POCKET GOPHERS (THOMOMYS BOTTAE) OF THE LOWER COLORADO RIVER Arizona University Ph.D. thesis, 1966. Order from: University Microfilms, Ann Arbor, Mich., Order No. 67-3960 134 pp. mi \$3.00, ph \$6.50

Several collections of pocket gophers (*Thomomys bottae*) have been made along the lower Colorado River since the 1890's. By using the specimens an analysis of temporal variation in the three subspecies inhabiting this area, T.b. albatrus, T.b. crysonotus, T.b. riparius, was made. The relationship of these subspecies to each other and to a population of T.b. collinus from El Coronado Ranch, West Turkey Creek Canyon, Chiricahua Mountains, Cochise County, Arizona, was determined. Comparisons were based on statistical interpretation of thirteen morphological measurements of skull and from study skins. Four hundred forty one specimens were available. Based on statistical parameters, the following conclusions were reached: Comparisons between the desert populations and the one from El Coronado Ranch showed the former to be significantly larger in eight of thirteen characters measured. Coefficients of variation for these two groups and two from previous studies were all similar for the characters measured, the greatest variability being found in the more subjective measurements, e.g., tail length, length of nasals. The report concluded that although the environment has an effect on populations in an absolute sense, some composed of individuals of larger size than others, the variability of character expression is relatively unaffected by environment. (LC-313)

26. Cole, Gerald A. AMERICAN SOUTHWEST AND MIDDLE AMERICA In: David G. Frey ed., Limnology in North America Madison, University of Wisconsin Press, 1963 pp. 393-434 biblio. DLC QH96.F7

Summary of the development and current status of limnology in the American Southwest and Middle America. Information given on studies made in Texas, New Mexico, Arizona, Mexico, Guatemala, El Salvador, Honduras, British Honduras, Nicaragua, Costa Rica and Panama, which deal with extinct lake basins, playas, basins of meteoric origin, high latitude lakes, deflation basins, solution basins, volcanic lakes, ponds, lagoons of Pacific Coastal lowlands, and reservoirs of the southwestern US. Details given on studies of lake thermics, chemistry and productivity. (LC-331)

27. Dale, Vernon B. TUNGSTEN DEPOSITS OF YUMA, MARICOPA, PINAL AND GRAHAM COUNTIES, ARIZONA US Bur. Mines Rpt. Inv. 5516, 1959 68 pp., 12 refs. DLC TN23.U43

Report describes briefly most of the known W deposits in Yuma, Maricopa, Pinal, and Graham counties, Arizona. Production figures given for each deposit, where known, and for each county. Reserve estimates made for the individual counties. The occurrence of W minerals is sporadic and discontinuous; hence, samples taken by conventional methods, other than bulk mining, are usually unreliable. Appendix contains a log of all assays made during this investigation. Most deposits examined contained shallow surface workings only. Virtually all of the commercial W ores had been removed as they were found, leaving only marginal and low-grade material exposed. Development workings found in only 3 areas, were not extensive. (LC-385)

28. Ross, Clyde P. THE LOWER GILA REGION, ARIZONA, A GEOGRAPHIC AND HYDROLOGIC RECONNAISSANCE WITH A GUIDE TO DESERT WATERING PLACES US Geol. Survey, Water-supply paper 498 237 pp., illus., map (in pocket), 1923. DLC TC801.U2

The region covered lies mainly in central Yuma County and western Maricopa County. Report is designed to give specific information regarding watering places and routes of travel within region covered along with general information on the geography, geology and hydrology of the area. Comprised of three parts; the first consists of general information covering the entire region; the second gives logs of all the principle routes and descriptions of the geology, geography, and water resources of all the localities traversed by these roads; the third gives detailed descriptions of all known watering places in the region. Relief maps of entire region showing the existing water supplies and a reconnaissance geological map included.

(LC-414)

29. Darton, Nelson H. A RESUME OF ARIZONA GEOLOGY Arizona University Coll. Mines & Engineering, bull. no. 119, geol. ser. n. 3 298 pp., 1925 DLC QE85.D3

Bulletin contains the principle data available up to 1925 concerning the succession of rocks in Arizona and the general structural features in most portions of the state. The work consists of two parts: 1) stratigraphic geology, a resume of the characteristics of the various formations; and 2) descriptive geology, which discusses many of the districts, mountains, plateaus and other features, arranged by counties. 74 illus., 105 sections and maps included.

(LC-427)

30. Marbut, C.F. 1935 SOILS OF THE UNITED STATES: ATLAS OF AMERICAN AGRICULTURE, PART III US Govt. Printing Office Washington DC

The best single source of information on soils of the US found by the workers of the project. First portions of report constitute a good general review of soil science including soils and parent material, soil classification, distribution of soils without normal profiles, the color-profile chart, approximate chemical and mechanical composition charts, and descriptions of the broad soil groups, Podzols, Gray-brown Podzols, Red and Yellow soils, Prairie soils, Podzolic soils, and the Pedocals.

Great care must be exercised in converting USDA types to the types mapped by WES, as the following data show: Sand -- all soils containing less than 20% silt and clay, the remaining being sand. Sandy Loams contain from 20 to 50 percent of silt and sand. Loams and Clays contain 50 percent or more of silt and clay combined. Clays -- contain 30 percent or more of clay and 70 percent of other classes.

Fairly detailed soil maps by groups of 4 or 5 states are included. Scale of maps, 1:2,500,000. A limited bibliography (18 entries) included.

31. Cooke, Ronald DESERT PAVEMENT California Division of Mines and Geol., Mineral inform. serv., v.18, no. 11: pp. 197-200, incl. illus., 1965. DLC HD9506.U63C35

Author concludes that the chief mechanism for origin of desert pavement is the upward migration of coarse fragments, aided by splitting after arrival at the surface. The wind removes finer particles, but is not an essential agent.

32. Merriam, C.H. 1893 NOTES ON THE GEOGRAPHIC AND VERTICAL DISTRIBUTION OF CACTUSES, YUCCAS, AND AGAVE IN THE DESERTS AND DESERT RANGES OF SOUTHERN CALIFORNIA, SOUTHERN NEVADA, SOUTHWESTERN ARIZONA, AND SOUTHWESTERN UTAH US Department of Agriculture No. American Fauna 7, Part II, pp. 285-343, pp. 345-59.

One of the earliest treatises on cacti and cacti-like plant distribution in California, Arizona, Nevada, and Utah. Author describes the general distribution of the various plants. He notes characteristics of the plants and lists the limits of their range as well as providing two or three specific localities where they may be found. No photographs or location maps are provided and his information is superseded by later and more detailed studies which are included in the bibliography.

33. Moore, Richard T. and Wilson, Eldred D. BIBLIOGRAPHY OF THE GEOLOGY AND MINERAL RESOURCES OF ARIZONA, 1848-1964 Arizona Bur. Mines bull. 173, 321 pp., 1965 DLC Z6739.U5A75

This bibliography is a comprehensive list of the literature released through December 1964 and includes, besides regularly published items, many thesis and open-file reports. Bibliographic items are grouped alphabetically under the surname of the senior author and chronologically under the name. A cross-referenced index accompanies the bibliography.

34. Cailleux, Andre and Wuttke, Krystyna MORPHOSCOPY OF QUARTZ SANDS IN WESTERN UNITED STATES (Morphoscopie des sables Quartzeux dans l'ouest des Etats-Unis d'Amerique du Nord). With English abstract. Bol. Paranaense geograf., nos. 10-15, pp. 79-87, incl. tables, 1964. DLC G1.B54

In California and Arizona sands, unworn quartz grains usually prevail, as often happens in regions with high relief or semi-arid conditions. However, some signs of wind-action (round and frosted, dull grains) are to be seen especially in some dune sands, and reworked pediments; and some water-action on the smooth and shiny grains of some beach sands while others are almost entirely unaltered.

35. Jaeger, E.C. DESERT WILD FLOWERS Revised edition (pprbk), Stanford University Press, Palo Alto, California, 1941 (repr. 1972) 322 pp., 74 illus.

The title of this book is somewhat misleading since in reality he investigates all of the flora of the desert regions of California, Arizona, and Nevada. He describes in some detail the vegetation of the region, presents line drawings of all of the flowering types. Included in the descriptions are discussion of the altitude control, the preferred desert landform types on which they occur, and the geographical range of the plant. Well illustrated with photographs and line drawings.

36. Harper, W.G., Poulson, E.N., and Foulger, J.C. 1941 YUMA DESERT AREA, ARIZONA, SOIL SURVEY US Dept. of Agriculture, Bureau of Plant Industry, Series 1938, no. 1, 35 pp.

The Yuma Desert area is in the southwestern part of Yuma County near the extreme southwestern corner of Arizona. The native vegetation is characteristic of extensive areas in the southwestern desert region, where a rather sparse stand of brush is prevalent. The mountainous areas include the lower slopes of the Gila Mountains --- rough, stony, rugged, and practically barren of vegetation. The Soils of this area are mapped in several types, series, and phases. The most important include the Mohave Series -- soil that lie mainly on alluvial fans, Whitlock Series -- fan soils and river terrace derived soils, The Superstition Series, which occur largely at lower elevations, and Miscellaneous land types.

An excellent soil map (1:62,500) from which dune areas, riverwash, and stony areas can easily be delineated is included.

37. Ward, Robert A. DESERT PAVEMENT Compass, v.39, no.1, Fall 1961, pp.3-8, incl. illus., 8 refs. DLC TN1.C793

The character of desert pavements as described by various writers is discussed. In light of their papers, the theories of origin are reviewed. A field study of a desert pavement in the Kofa Mountains of southeastern Arizona revealed that the pavement was formed by a combination of wind and water action. Approximately 26 in. of loam had been removed by these agents in order to form the pavement.

38. Pianka, Eric R. ON LIZARD SPECIES DIVERSITY: NORTH AMERICAN FLATLAND DESERTS Ecology 218 (3) 1967 pp. 333-51 MGA 18.11-455

Eight potential mechanisms for the determination of each species diversity are described and discussed, and data relevant to each are presented for a particular diversity gradient: namely that of the flatland desert lizards of western North America. It is concluded this ecological time, spatial heterogeneity, length of growing season, and amount of warm season productivity are all factors which determine the total number of lizard species occurring on an area, but that the most important single factor is the spatial heterogeneity (mainly vegetative) of the environment. It is suggested that climatic variability allows the coexistence of many different plant life forms, the variety of which in turn controls the number of lizard species. (AZ-450)

39. Brooks, Wahner E. GLOSSARY OF DESERT ENVIRONMENTAL TERMINOLOGY, included in Test Operation Procedure 1-1-006, DESERT ENVIRONMENTAL CONSIDERATIONS, US Army Test and Evaluation Command, Aberdeen MD. 10 August 1972. pp. D1-D83 1 table

The glossary offers definitions and preferred useage for over 1200 terms associated with the desert environment. Both English (specialist and colloquial included) and foreign terms are included with emphasis on surface features.

40. Chew, R.M. and Chew A.G. THE PRIMARY PRODUCTIVITY OF A DESERT-SHRUB (LARREA TRIDENTATA) COMMUNITY Ecological Monographs 35 (4) 1965 pp. 355-75 (BA(47)50495. BA(30)8500)

A community in SE Arizona was studied. Larrea found in reverse proportions to depth of soil above dense caliche.

41. DeWitt, C.B. PRECISION OF THERMOREGULATION AND ITS RELATION TO ENVIRONMENTAL FACTORS IN THE DESERT IGUANA, DIPSOSAURUS DORSALIS Physiological Zoology v.40 1967 no.1 pp. 49-66 (BA(48)54582)

Desert iguanas exercise control over their body temperature by appropriate adjustment of their position in gradients of temperature. Under natural conditions of the desert in Riverside County, California, temperatures quickly reach levels too high to permit regulation of body temperatures at the preferred level on or above the surface of the ground. Desert iguanas do not immediately retreat to burrows under these conditions, but they stay above ground until they become heated to 43-44 degrees centigrade. On the hottest summer day, this tolerance of temperatures above the preferred range may increase the time suitable for activity above ground from 0.5 to above 3.0 hours. (A1-268)

42. Arizona Land Department, Water Resources Report Series ANNUAL REPORT ON THE GROUND WATER IN ARIZONA

The economy of Arizona, particularly the agricultural economy, is largely dependent on ground-water supplies for future growth and even for its continued existence at the present level. More than two-thirds of the water supply for the state is taken from ground-water reservoirs. These reports provide a summary of basic hydrologic data collected from springtime to springtime each year based on approximately 3000 water-level measurements from all countries.

43. Lowe, C.H. Heed, W.B., and Halpern, E.A. SUPERCOOLING OF THE SAQUARO SPECIES DROSOPHILA NIGRASPIRACULA IN THE SONORAN DESERT Ecology, 48 1967 pp. 984-85 (BA(49)91720)

The ability to withstand winter nocturnal temperature extremes makes it possible for the species to be active and breed throughout the winter over the geographical distribution of its primary host plant, the saquaro (cereus giganteus). (A1-622)

44. Peirce, H. Wesley and Scurlock, James R. ARIZONA WELL INFORMATION Bulletin 185, The Arizona Bureau of Mines 1972

Lists the reported wells, (including location, name and driller, elevation and stratigraphy) of Arizona. Of the 16 listed for Yuma County, none are in or adjacent to USAYPG.

45. Schafer, Howard C. HIGH TEMPERATURES IN FIELD STORAGE ENVIRONMENTS (Naval Weapons Center, China Lake, California) The Journal of Environmental Sciences v.19, no.6 pp. 39-40 Nov/Dec 1976

Schafer discusses the collection and interpretation of statistical data relating to high temperatures at 11 geographic locations around the world. China Lake was used specifically for the determination of hot, desert-induced temperature responses of ordnance. A cumulative chance of occurrences display is presented with interpretations. The display enables test engineers to quickly determine what type of test most closely represents the projected use of a test item in real life.

46. Schmidt-Nielsen, K. et al THE JACK RABBIT, A STUDY IN ITS DESERT SURVIVAL Hualradets Skrifter no.48 pp. 125-142 1965 (BA(48)16090)

Field and laboratory studies were carried out on Lepus alleni and L. californicus to ascertain how the jack rabbit is able to survive the hot, dry desert. The results showed that evaporation of water is essential for the maintenance of safe body temperatures during heat load. The heat load, and therefore the used water, is reduced by seeking shade. Other factors that contribute are the insulation and reflectivity of the fur. (A1-887)

47. Williams, Llewelyn A CONTRIBUTION TO THE PHILOSOPHY OF CLIMATIC DESIGN LIMITS FOR ARMY MATERIEL: EXTREME HOT-DESERT CONDITIONS Technical Report ETL-TR-72-5, US Army Engineer Topographic Labs, Fort Belvoir, Va., June 1972 60 pp. 22 refs., 31 fig., 3 tab.

The 1,5, and 10 percent frequencies of high temperature were obtained for the severest month and the severer four months for the period from 1948 to 1967 for the SW desert of the US, and maps (ap. 1:3,000,000) showing these frequencies are given. Figures include: dependence of vertical solar and total hemispheric radiation on dewpoint temperatures during days with average afternoon temperatures of 105 degrees and higher at USAYPG; comparison of radiation-temperatures regimes at China Lake, California, and USAYPG for the July of 1964 and 1966; afternoon average (5 hours) ground surface and 1 inch depth temperatures plotted against afternoon average air temperature at USAYPG; . . . (the sums) . . . plotted against vertical radiation for days with average afternoon temperatures of 105 degrees F and higher at USAYPG.

48. Sellers, William D. and Hill, Richard H. ARIZONA CLIMATE 1931-1972, revised 2nd ed. University of Arizona Press, Tuscon, Arizona 1974 616 pp. (15BN-0-8165-0466-0; L.C. no. 74-7880)

The most recent summary of Arizona climate available with temperature and precipitation records for Aqua Caliciste (1931-37), Dateland (1952-68), *Kofa Mountains (1952-72), *Ehrenberg (1941-72), *Quartzsite (1931-41, 60-72), *Mohawk (1931-50 e), Sentinal (precip. only, 1950-59), Tacna 3NE (1969-72), *Wellton (1931-72), Yuma (1948-70, precip. only, incl. winds and cloudiness), Yuma WSO Ap (1950-72), *Yuma Citrus (1931-72, incl. evaporation), and Yuma Proving Ground (1958-72).

* Included are narrative comments on these stations. All station histories are included.

49. Davis, W.M. 1936 GEOMORPHOGENIC PROCESSES IN ARID REGIONS AND THEIR RESULTING FORMS AND PRODUCTS Report of XVI Intl. Geol. Cong., v.2 pp. 703-14

Peculiar land forms of the desert are due largely to (1) the paucity of plant growth, in consequence of which (2) disintegrated rock, produced more by physical than chemical processes, with (3) variations due to rock nature (hence granitic rocks assume forms of special interest) (4) the disintegrated rock does not remain near its source long enough in the earlier stages of erosion to be reduced to a very fine texture before (5) it is carried by stream-floods or sheetfloods toward or to (6) playa basins of rising base level; but in the advanced stage of the arid cycle (7) the playa surface may be lowered by the wind, whereupon the rock slopes previously weathered down to sheetflood grade and buried with respect to sinking base-level, and the buried rock floors will be laid bare until again reduced to sheetflood grade. But (8) in deserts draining to the ocean these various processes will work with respect to a relatively fixed baselevel, also (9) in deserts where the action of water floods is dominated by wind action, the carving of the surface will be in part independent of any baselevel.

Of general interest with regard to desert landforms. No photographs or maps.

50. Davis, W.M. 1938 SHEETFLOODS AND STREAMFLOODS Bull. Geol. Soc. Am., v.49 pp. 1337-1416 15 pls., 33 figs.

Excellent although highly theoretical on the role of sheet-floods and streamfloods in the formation of pediment slopes. "Sheetfloods, not streamfloods, normally grade piedmont slopes and the fan lays where desert mountain valley open out between diminishing spurs. Where gradual uplift or other moderate changes allow streamfloods to take mild possession of these graded areas, their work too is almost entirely downwearing rather than lateral cutting." Based mainly on the author's observations in the Mohave Desert region. Detailed descriptions of some localities and numerous photos make the work a valuable one, especially for the slope and soil maps.

51. Darton, N.H., Lausen, C., and Wilson, E. 1928 GEOLOGIC MAP OF ARIZONA Arizona Bureau of Mines and US Geological Survey Map

A colored map on a single sheet at a scale of 1:500,000 of the state of Arizona. The geologic column is shown on the side of the map and alluvial and rock areas are mapped on it. Some drainage, playas, and dune areas are either indicated or can be inferred from it. A source for the surface rock map, although the Yuma Proving Ground area is of low precision.

52. Darton, N.H. et al 1916 GUIDEBOOK OF THE WESTERN US, PART F, THE SOUTHERN PACIFIC LINES US Geol. Surv. Bull., no. 845

A geologic, topographic, and economic description of the land along the Southern Pacific right-of-way from New Orleans to Los Angeles and San Diego. The maps are presented in strips approximately one degree of latitude and longitude each. Outstanding topographic features as buttes, peaks, plains, mountain ranges and basin, are studied and described with adequate photos and cross-sections where needed. In Arizona and New Mexico the Basin and Range province dominates the landscape, with bolsons filling the troughs between long, parallel ridges of mountains. Thence, the mountains that protect the southern California lowland, and cut off moist air from the ocean, are encountered as a rugged ring around Los Angeles.

Illustrations in the form of photos are numerous throughout the paper as are geologic maps, the best of which are relatively small areas in New Mexico, Arizona, and California.

53. Buxton, P.A. 1955 ANIMAL LIFE IN DESERTS -- A STUDY OF FAUNA IN RELATION TO ENVIRONMENT Edward Arnold Ltd., London 176 pp.

A very general, popularized account of animal life in desert regions, including life in the Sahara, Palestinian, Libyan, and North American deserts. The first few chapters are introductory and references are made to Desert Climate, Soils and Watercourses, Floral Environment, and the Relationship between Animals and Plants in the desert. Sections on soils and plants are of general interest but of no specific application to the present investigation.

54. Boardman, L. and Bove, A. 1957 GEOLOGIC MAP INDEX OF ARIZONA US Geological Survey, Map Index Series 1 sheet scale 1:1,000,000

An outline map of Arizona prepared by the US Geological Survey on which areas covered by geological reports are plotted. A very helpful source of information for preparation of surface rock and related maps.

55. Forrester, J.D. and Moore, Richard T. GEOLOGIC AND MINERAL MAPS OF ARIZONA Tucson, Arizona Bureau of Mines

Bulletin is to assist the reader in comprehending how a given map may be used and interpreted most satisfactorily to gain full knowledge of the information being portrayed by the map and to supplement several maps which are component parts of the Folio of Geologic and Mineral Maps of Arizona Bureau of Mines. Also a companion piece to Bulletin 171 of the Bureau titled A Resume of the Geology of Arizona by Eldred D. Wilson, geologist.

56. Gary, H.L. and Campbell, C.J. WATER TABLE CHARACTERISTICS UNDER TAMARISH (TAMARIX PENTANDRA) IN ARIZONA US Forest Service, Research Note RM-58 1965 pp. 7 (BA(30)53222)

Evapotranspiration under a common phreatophyte.

57. Gay, C.W. CONTROL CHOLLA CACTUS BY MECHANICAL AND CHEMICAL METHODS New Mexico State Univ. Cooperative Extension Service, Livestock Guide 400B-804 (circa 1965) 2 pp. (WA(15)1515)

Cholla cactus (Opuntia spinosius) is a particular problem on rangeland where the grass cover is depleted by drought and over-utilization. Grubbing gives effective control, during winter or under conditions of drought. Chemical treatments are also recommended for the control of O. spinosius. Plants should be sprayed as soon as growth becomes visible in May.

58. McClanahan, L. Jr. ADAPTATIONS OF THE SPADEFOOT TOAD, SCAPHIOPUS COUCHI, TO DESERT ENVIRONMENTS Comparative Biochemistry and Physiology 1967 20(1) pp. 73-97 illus. (A1-662;BA(48)70006)

Scaphiopus couchi avoids the inclemencies of the desert environment by burrowing into the ground for approximately 10 months out of the year, but simultaneously encounters the problems of food storage and water conservation. Toads store nitrogenous wastes and conserve water. Field and lab data indicate that toads are capable of storing fat and metabolizing it during hibernation. Water is lost principally from interstitial fluids. Stored, dilute bladder urine may be utilized by toads to replace water deficits in body fluids.

59. Mayhew, W.W. ADAPTIONS OF THE AMPHIBIAN, SCAPHIOPUS COUCHI, TO DESERT CONDITIONS American Midland Naturalist 1965 74(1) pp. 95-109 (A1-656;BA(47)14937)

Spade foot toads (scaphiopus couchi) have been discovered recently in the Colorado Desert, a region averaging approximately 2½ inches of rainfall per year and having very high summer temperatures (to 50 degrees C). This is one of the driest and hottest areas in North America. The species was apparently more widely distributed along the California side of the Colorado River in an earlier pluvial period.

60. Anthony, M., and Epler, W. UPPER ATMOSPHERE WINDS FROM GUN LAUNCHED VERTICAL PROBES (Yuma, November 16-19, 1966) BRL Contract 169, rept, no.6 1967d. Also: UPPER ATMOSPHERE WINDS FROM GUN LAUNCHED VERTICAL PROBES (Yuma, October 26-27, 1966) BRL Contract 169, rept. no.7, 1967b. AD 662 727

61. Fuller, R.N. UPPER ATMOSPHERE WINDS FROM GUN LAUNCHED VERTICAL PROBES (Yuma, June 13-15, 1966) BRL Contract 169, rept. no.4, 1966 AD 662 727

62. Axelrod, Daniel I. EVOLUTION OF DESERT VEGETATION IN WESTERN NORTH AMERICA Washington Carnegie Institution Pub. 590 pp. 215-306 1950 DLC AS 32.A5

Temporal succession of angiosperm floras from areas now desert and subdesert in western North America shows that subtropical and warm-temperate forests dominated over the lowlands of the present desert regions from Upper Creta-

ceous into early Tertiary time: that temperate deciduous and conifer forest, arid subtropical forest and scrub, live oak woodland, and chaparral characterized these areas during the middle and later Tertiary; and that grassland and scrub became prominent during the Middle Pliocene. Present desert environments of subcontinental extent are of the later Cenozoic age. Present desert plants apparently have been derived from species represented in the major Tertiary Floras which occupied the desert regions. During much of Tertiary time ancestors of modern desert species were evolving rather slowly in localized subhumid climates on the borders of the Arcto Tertiary, Madro Tertiary, and Neotropical Tertiary Floras. The more mesic communities of these Floras had largely been eliminated from lowland areas over the present desert region by Middle Pliocene time. As open environments of subcontinental extent now came into existence, the semiarid shrub, herb, and grass communities which were restricted earlier to the borders of the more mesic vegetation types spread widely and evolved rapidly. But even at this later date desert conditions appear to have been largely subordinate to grassland, which seems to have characterized the lowlands of the present desert region. During the fluctuating late Cenozoic climates and continued topographic differentiation, a host of new forms adapted to desert climate, came into existence. Many of them find their ancestors in species which now contribute to the vegetation on the borders of the desert, communities which were well represented by equivalent species over the lowlands of the present desert area during Pliocene time. Desert floras elsewhere in the world may have followed the same general pattern in evolution. Their age appears to be late of vegetation in the Cretaceous and Tertiary than exist in those areas today. Thus there seems to be no evidence that desert environments of modern distribution have been in existence since the early Cretaceous. Although desert environments have been called "earth-old features", they may more appropriately be termed "climatic accidents", for they seem to have been rare in earth history.

63. Moore, R.T. and Wilson, E.D. GEOLOGIC CROSS-SECTIONS AND INDEX MAP FOR GEOLOGIC CROSS-SECTIONS OF ARIZONA Tucson, Arizona Bureau of Mines, 4 sheets 1962

64. Frost, Robert E., Shepard, James R., et al TERRAIN STUDY OF THE YUMA TEST STATION AREA, ARIZONA contract no. DA-27-079-ENG-134; DA Project No. 8-97-10-004, Engineering Experiment Station, Purdue University, March 1955 (typescript) 176 pp., 67 illu., 4 tables, 4 maps, 28 refs.

The subject of the study is the terrain and environmental features of the Yuma Test Station (Yuma Proving Ground). Data for the study are the result of three field surveys, study of aerial photography, review of literature and existing maps and congerences with authorative sources. The report is limited to development of a terrain and surface sondition classification system, and discussions of local ecology, terrain units, and military significance. Later work has superseded the surface material data, but the other information and photography is of considerable value.

65. Luechitta, Iva EARLY HISTORY OF THE COLORADO RIVER IN THE BASIN AND RANGE PROVINCE The Geological Society of America Bulletin, v.83 pp. 1933-48 July 1972

Interpretation of the geologic history of the Colorado River in the Basin and Range province based on the work done by geologists in the Imperial Valley, the Parker-Blythe-Cibola area, and the Lake Mead and Hualapai Plateau areas. Develops hypothesis Colorado River developed as a result of Gulf of California invasion of the bouse embayment.

66. Simpson, Eugene S. GROUND-WATER HYDROLOGY An Inventory of Geographical Reasearch on Desert Environments, v.8, Office of Arid Lands Studies University of Arizona, Tucson, Arizona 1967

The report includes a general discussion of desert ground water hydrology; the hydrologic balance; aquifers and water storage beneath deserts; information sources, accessibility, and a bibliography.

67. Correll, Donovan S. and Correll, Helen B. AQUATIC AND WETLAND PLANTS OF SOUTHWESTERN UNITED STATES Environmental Protection Agency, Water Pollution Control Research Series, (LC 72-6000-67; GPO 5th no.5501-0177), US Government Printing Office January 1972 (XV) 1777 pp. 789 illus.

The primary aim of this work is to provide a taxonomic treatment of the species known as hydrophytes. Sufficient to enable one to identify ferns and flowering plants that grow naturally in aquatic and wetland habitats in Arizona, New Mexico, Texas and Oklahoma. The basic criterion for the inclusion of a species is the ability to withstand a permanent or seasonally long submersion of at least its root system. In addition, plants classified as phreatophytes, or those plants whose deeply penetrating roots tap the ground water, are included. The introduction includes discussions of habitats, peculiarities, and distribution, and control.

68. Olmsted, F.H., Laclitz, O.L., and Burdge, Ireland GEOHYDROLOGY OF THE YUMA AREA, ARIZONA AND CALIFORNIA Geological Survey Professional Paper 486-H, US Government Printing Office, Washington DC 1973 (stk no. 2401-02391; LCC no. 73-600011)

The report defines the geology sufficiently to delineate the ground water reservoir, determine the sources of ground water and the relation between ground water and surface water, define the hydrologic characteristics of the aquifer system, determines the movement of ground water in different parts of the area, calculates ground water budgets for both past and present conditions, and describes the chemical quality of the ground water. The study area includes the south western portion of USAYPG.

69. McGinnies, William G., Goldman, Brian J., and Paylore, Patricia DESERTS OF THE WORLD University of Arizona Press 1968 (LC 68-9338)

An inventory of geographical research on desert environments including geomorphology, geology, surface materials, flora and fauna, weather and climate, coastal zones and desert regional types. The purpose of the inventory is to determine in detail what topics have been investigated, to appraise the reported work and disclose areas of study where further work is needed. The recapitulation of all information known about the world's deserts is not intended. Rather the book is a compendium-guide to past and present research.

70. Thornburg, William D. REGIONAL GEOMORPHOLOGY OF THE UNITED STATES (LC 65-12698) John Wiley and Sons, Inc., New York, 1965 (viii) 609 pp., 320 illus.

This book is designed to provide a text for geomorphology as well as a reference for non-specialists who wish to familiarize themselves with geomorphology of particular regions. A chapter is included on the Basin and Range Province, with a useful bibliography. The section on the Sonoran Desert is not treated in depth, better works of a similar nature are available (C.F. Hunt) but this work is often cited in other works on the region.

71. Garvin, Lester E, and Pascucci, Richard F. REMOTE SENSING AND ANALYSIS OF SOILS AND VEGETATION RESOURCES IN THE CALIFORNIA DESERT incl. in. Proc., 4th Annual 1973 Conference on Remote Sensing in Arid Lands, University of Arizona, Tucson, Arizona, 1973

Paper describes a resource inventory for BLM of portions of the Colorado and Mojave Deserts. Field reconnaissance and validation are integrated with aerial image analysis. Digital files were prepared from thematic overlays, and were computer processed for correlation into ecological unit associations.

72. Rogers, Malcolm J. ANCIENT HUNTERS OF THE FAR WEST Union Tribune Publishing Co., San Diego, California 1966 (LC 66-22900)

Based on archeological findings and paleogeographic inferences, the development and culteres of the four prehistoric cultures in the Southwest are described. Three of these, the Amargosa, San Diequito, and Yuman Complexes are contained in the Southeast Province (lower Colorado River Basin). Various sites and artifacts are described.

73. Kerr, Richard C. AUTOMOTIVE TRANSPORTATION IN SAUDI ARABIA Bound Report Methodology and Instrumentation Library brown folder

That portion of Saudi Arabia bordering on the Persian Gulf known as the Hedjaz, occupies an area about the length of the Atlantic Coast of the US. and in width extending into the east side of the Mississippi Valley.

The climate is similiar to that of Imperial Valley, California and the desert areas of New Mexico. Summer months are cool and extremely hot, and the winter months are cool and dry. The terrain is partially covered with sand dunes but the sands occur in long narrow strips that cannot be detoured. It was necessary therefore to devise motor equipment that could cross such areas. This paper is confined to the problems of sand mobility and heat dissipation from the engines.

74. Hastings, James Rodney and Turner, Raymond M. THE CHANGING MILE: AN ECOLOGICAL STUDY OF VEGETATION CHANGE WITH TIME IN THE LOWER MILE OF AN ARID AND SEMIARID REGION Tucson, University of Arizona Press, 1965 317 pp., incl. illus., maps, refs. DLC QK938.D4H37

The role of man and climate in altering arid lands of the southwest US and northwest Mexico is explored. In determining what changes have taken place, historical records have been employed by many climatologists and geographers to recreate the climate and vegetation of the past. Repeat photography was also used and 97 pairs of matched photographs, taken from the same vantage point 85 years ago and again in 1963, are presented. Chapters include the influence of Indians, Spaniards, Mexican and Anglo-Americans; the oak woodland; the desert grassland; the patterns of change; and some hypotheses of vegetation change. Appendices include lists of scientific and common names of plants used in the text and location and elevation of photographic stations. Extensive bibliography.

75. Melton, Mark A. DEBRIS-COVERED HILLSLOPES OF THE SOUTHERN ARIZONA DESERT -- CONSIDERATION OF THEIR STABILITY AND SEDIMENT CONTRIBUTION Jour. geol. v.73, no.5 pp. 715-729 incl. illus., tables, graphs, refs. September 1965 DLC QE1.J8

Discusses how the various processes that effect hillslopes in the Sonoran Desert of southern Arizona vary considerably in relative importance, depending upon elevation (and hence, climate), angle of slope, and the nature and weathering properties of the bedrock.

76. Fenneman, Nevin M. PHYSIOGRAPHY OF WESTERN UNITED STATES
McGraw-Hill Book Co., New York 1931 534 pp., 173 illu.,
1 map

The intent of this work was to establish order in the large amount of geologic literature on the Western United States and to organize the knowledge in an attempt to interpret the physiographic history of this area. Since superseded by more recent works (C.F. Hunt, 79), the work is still important as source material. The author identifies and describes provinces still followed, including the Basin and Range Province, which included the Sonoran Desert. A general description of the Gila Desert (which is now generally included in the boundaries of the Yuman Desert) is provided, as well as discussions on climate, specific land forms, and the Colorado River.

77. Hunt, Charles B. PHYSIOGRAPHY OF THE UNITED STATES W.H. Freeman and Co., San Francisco 1967 (LC 66-24952)

A comprehensive description of the physical geography, geology, climate, soils, vegetation, resources, and related phenomena in the natural regions of the United States. A chapter is devoted to the Basin and Range Province including the Sonoran Desert.

78. Stebbins, Robert C. FIELD GUIDE TO WESTERN REPTILES AND AMPHIBIANS No.16 in the Peterson Field Guide Series, Houghton Mifflin Co., Boston 1966 (ISBN: 0-395-08211-0, LC 66-16381)

The guide includes descriptions, identifying marks, food and habitat data, and distribution maps for the salamanders, frogs, toads, turtles, lizards and snakes found in the Western United States.

79. Shreve, Forrest and Wiggins, Ira L. VEGETATION AND FLORA OF THE SONORA DESERT v.1, 840 pp., incl. illus., maps, refs. v.2, 900 pp., incl. maps Stanford, Stanford University Press, 1964 DLC QK938.D4S49 1964

The standard publication on the vegetation of the Sonoran Desert: with a critical analysis and description of the vegetation; physical features, perennial vegetation, ephemeral herbaceous vegetation, and ecological features of characteristic species. Consists of a classical floristic

treatment, a manual with keys to families, to genera within families, and to species, detailed technical descriptions of each taxon, statements of general and local geographic distribution and critical notes on habitat, time of flowering and other factors for each species. Woody and herbaceous plants are included with complete synonyms.

80. Niering, W.A., Whittaker, R.H. and Lowe, C.H. THE SAGUARO: A POPULATION IN RELATION TO ENVIRONMENT Science v.142 no. 3588 pp.15-23 incl. illus., 1963 DLC Q1.S35

The saguaro (Cereus giganteus, Carnegiea gigantea) is a major plant of the Sonoran Desert. The center of maximum population density in the Tucson area is on the driest slopes of mountains, at low elevations; the finest stands of large individuals occur on some of the upper parts of the valley plains or bajadas. Toward higher elevations in the mountains the population is limited by low winter temperatures, which periodically kill large proportions of the population by freezing. Down the bajadas slopes the population is limited by occurrence of finer soils and by other factors. Grazing subjects the population to gradual disaster, with slow decline to disappearance resulting from failure of the saguaro to reproduce. When the effects of grazing are far advanced and rodent populations are high, as in parts of Saguaro National Monument, these effects are largely irreversible.

81. Brooks, Carol L. HUMAN ENGINEERING BIBLIOGRAPHY Technical Memorandum QA-4-67, US Army Yuma Proving Ground, Yuma, Arizona 85364 October 1967 16 pp.

This report consists of a selection of 37 references to the effects deserts and desert related phenomena, such as high temperature, on human performance. Includes abstracts and separate author and subject indices.

82. Brooks, Wahner E. INFLUENCE OF TERRAIN ON DESERT ENVIRONMENTAL TESTING Technical Memorandum MI-9-68, US Army Proving Ground, Yuma, Arizona, 85364, April 1968 47 pp., 17 illus., 12 tables, 31 ref.

Report covers effects of terrain on desert environmental testing. Following brief discussions of deserts and desert types, the components of the desert are described quantitatively. Testing requirements are then specified in terms of these components and soil parameters. Recommendations include test notes and courses at Yuma Proving Ground.

83. Dodge, Natt N. and Janish, Jeanne R. FLOWERS OF THE SOUTH-WEST DESERTS 7th ed. 1969, Popular Series No.4, Southwestern Monuments Association, Globe, Arizona, 1951, 1952, 1954 112 pp., 100 fig.

This booklet makes available names of, and information about, some of the common and conspicuous plants of the Lower Sonoran Life Zone (below 3,000 ft., see also 89). Serves as a useful supplement for identification.

84. Patraw, Pauline M. and Janish, Jeanne R. FLOWERS OF THE SOUTH-WEST MESAS 4th ed. 1964, Popular Series No.5, Southwestern Monuments Assoc., Globe, Arizona, 1951, 1953 112 pp. 100+ fig., 20 ref.

The purpose of this booklet is to make available names of, and information about, some of the common and conspicuous plants of the Upper Sonoran Life Zone (approx. 3,000 ft. to 7,000 ft.; see also 88). Serves as a useful supplement for identification to Shreve and Wiggins (81) and Benson and Darrow (207).

85. Dodge, Natt N. 100 DESERT WILDFLOWERS IN NATURAL COLOR 2nd rev. 1971, Southwest Parks and Monument Assoc., Globe, Arizona 1963 (LC 63-13471; SBN 0-911408-30-4) approx. 60 pp., 100 illu., 12 ref.

Provides color photographs supplementing previous work "Flowers of the Southwest Deserts" (see 88).

86. Lowe, Charles H. ARIZONA'S NATURAL ENVIRONMENT (ISBN 0-8165-0349-4) University of Arizona Press, Tucson, Arizona 1964 papbk. 136 pp., 66 illu.

Information on Arizona landscapes and habitats, extracted from "The Vertebrate of Arizona" (Lowe, 82) including discussions of the Arizona Life Zones, sequence of the biotic communities and zones, biomes, biotic provinces, faunal areas, and floristic elements throughout Arizona. Considerable treatment is provided the Southwestern Desert scrub of the Sonoran Desert, summarizing several other works. A useful bibliography is included (440+ ref.).

87. Ernst, Carl H. and Roger W. Barbour TURTLES OF THE UNITED STATES University Press of Kentucky, Lexington, Kentucky, 1972 (ISBN 0-8131-1272-9 LC 72-81315) 347 pp., 220+ illu., 1200+ ref.

Extensive information on the turtles found within the United States, including descriptions, identification marks, habitat information, food and feeding habits, predator information, populations and distribution maps. USAYPG species include Sonoran mud turtle (Kinosternon sonoriense), desert tortoise (Gopherus agassizii) and the spiny softshell (Trionyx spiniferus).

88. Soil Conservation Society of America, LANDSCAPING WITH NATIVE ARIZONA PLANTS (Natural Vegetation Committee, Arizona Chapter) University of Arizona Press, Tucson, Arizona 1973 LC 73-76309; ISBN 0-8165-0385-0 194 pp., 65 illu., 1 map, 18 ref.

Major climatic and land resource areas are indicated on a map of Arizona. Fourteen major vegetation types are described, and important species adapted to each soil and vegetation type are listed. Nearly three hundred major species are listed by common and scientific name and cataloged in the categories of trees, shrubs, cacti, forbs, and grasses and grasslike plants. Plant characteristics are described and photos of characteristic species are included to aid in identification. Recommendations are made for collecting and planting seeds, transplanting, landscaping, and caring for the different types of plants.

89. Ohman, Howard L. and Richard L. Pratt YUMA WINTER MICROCLIMATE Technical Report 66-7-ES, US Army Natic Laboratories, Natic, Mass., June 1966 33 pp., 23 illu., 13 ref.

Study consists of an analysis of winter temperatures at and near the ground and wind velocities at standard heights, at three sites within Yuma Proving Ground. Two sites were selected for their representativeness of surface types characterizing the desert basins of southwestern United States. The third site was selected to represent the many low rocky mountain areas of the desert. The study develops information on the nature of diurnal temperature fluctuations, based on hourly records of temperature of January and February 1957, at ten levels ranging from 25 centimeters below ground to 200 centimeters above ground surface. In addition, hourly records of wind speed and direction at the standard shelter height were kept and analyzed.

Results show that the temperature regime at ground level differs markedly from that for the "standard" or 200-centimeter level at all sites, particularly in diurnal range, both actual and average (at Desert Pavement the average temperature range is 37 degrees F at the surface and 22.4 degrees F at 200 centimeters). Some differences in temperature from site to site were also noted, the most significant being the higher nighttime temperatures at Laguna Top the most elevated station, as compared to those for the two lower stations, Sandy Plains and Desert Pavement (average over 6 degrees F at the surface and 7 degrees F at two meters). Strong radiation cooling and air drainage into low areas resulting in the formation of nighttime inversions account for the lower daily minimum temperatures at the two low-lying stations.

90. Hevly, Richard H., Peter J. Mehringer and Harrison G. Yocum
MODERN POLLEN RAIN IN THE SONORAN DESERT Arizona Acad.
Sci., jour., v.3, no.3 pp.123-135, incl. illus., graphs,
tables, map, 30 ref. April 1965 DLC unbound

A study of "pollen rain" initiated to provide data for the interpretation of the postglacial pollen records from desert grassland of southern Arizona. Samples were collected from two desert areas near Yuma to include a number of vegetation types. Concluded that there is no regional pollen rain in either the desert or desert grassland --- within both vegetation types, either cheno-am or compositae pollen may be locally dominant. Most of the important pollen producers are controlled by local edaphic factors and do not necessarily reflect regional climate. Major changes in the relative frequencies of non-arboreal pollen types from a single pollen profile do indicate changes in the pattern of local vegetation which are the result of edaphic changes related to climatic or geologic factors.

91. Humphrey, Robert R. DESERT GRASSLAND: A HISTORY OF VEGETATIVE CHANGE AND AN ANALYSIS OF CAUSES Arizona University
Agricultural Experiment Station, Bull. 299; 56-62, 1958
Also Botan. rev., 24 (4): pp. 246-52, April 1958, refs.
DLC QK1.B335

Extensive portions of the desert grassland of southern Arizona, New Mexico and southwestern Texas, have been invaded by woody species. Mesquite, Creosote Bush, Cacti of the genus *Opuntia*, Borrowweed and Snakeweed are among the principal invaders. Prime factors commonly believed to have caused this change are reviewed and evaluated. These are (1) change of climate, (2) grazing by domestic livestock, (3) plant competition, (4) rodents, and (5)

fire. Change of climate seems to have had the least effect. Fires that were formerly frequent and widespread were the chief agency restricting shrub invasion. Since fires have been controlled, the introduction of domestic livestock, plant competition and rodents have been effective agents that have favored woody plants at the expense of grasses. Had fires continued to sweep the grasslands down through the years to the present with their original frequency, the desert grassland would probably occupy about the same area today as it did prior to the white settlement of the Southwest.

92. Rue, Leonard Lee, III PICTORIAL GUIDE TO THE MAMMALS OF NORTH AMERICA Thomas V. Crowell Co., New York, 1967 299 pp., 108 illu., 65 maps, 38 ref. LC 67-12408

A popular presentation on mammals, including photographs, small scale distribution maps, and track drawings of selected animals. For the purpose of the inventory, does not add to Burt and Grossenheider or Cockrum. Mammals described include the Red Bear, Black-tailed Jack Rabbit, Beaver, Muskrat, Norway Rat, House Mouse, Porcupine, Raccoon, Ringtail, River Otter, Spotted and Striped Skunks, Badger, Gray Fox, Coyote, Mountain Lion, Bobcat, Mule Deer, Pronghorn and Bighorn Sheep.

93. Kolb, Charles R. and J.H. Shamburger PROJECT OTTER (OVERLAND TRAIN TERRAIN EVALUATION RESEARCH); PRETEST REPORT US Waterways Expt. Sta., Tech. Rept. no.3-588, Rept. 1, 29 pp., incl. illus., 1961 DLC

Projects concerned with terrain analysis and evaluation have been conducted at the US Waterways Experiment Station (WES) for several years, and a classification system and technique for mapping terrain factors have been developed. Many deserts, including that at Yuma, have been mapped. From the Yuma terrain factor maps, test courses for the overland train, a logistical cargo carrier, were tentatively selected. A major field investigation was then conducted of the courses. Terrain types classified according to the WES system along 9 of the courses are tentatively compared to the terrain of world deserts.

94. Greenwood, N.H. and Richard D. Wright (San Diego State College) TRESSPASS OCCUPANCY ON FEDERALLY WITHDRAWN LANDS OF THE LOWER COLORADO RIVER: A STUDY IN CHANGING LAND-USE DEMANDS paper presented at the 63rd annual meeting, Assoc. of Am. Geographers, St. Louis Missouri, April 1967

In the years since the end of World War II, user demands upon land and water resources along the Lower Colorado

River have been increasing in a rapid and largely uncontrolled manner. Indicative of the unforeseen pressure on the resources of the area is the presence of widespread preemptive trespass on federally withdrawn lands. This situation, which has blossomed into a problem of staggering proportions, stems in large part from the rapid acceleration of recreational and residential demands, combined with constantly increasing land-values for all purposes. The problems occasioned by the potential conflict of interest between the residential claimants and the recreational planners are well illustrated by the case of Trader Horn. Here, three distinctive groups utilize the recreational resources of the Colorado River and the adjacent lands in varying degrees of intensity. Permanent residency represents the lowest intensive use of the area's recreational facility. Somewhat greater use of the river for recreation is made by the winter inhabitant whose domicile functions both as a seasonal home and a recreational facility. The greatest intensity is exhibited by the weekend resident whose structure is utilized essentially as a recreational facility. (From abstracts, annals, Am. Assoc. of Geographers, v.57, no.4 (Dec.67), p.789).

95. Mammerickz, Jacqueline QUANTITATIVE OBSERVATIONS ON PEDIMENTS IN THE MOJAVE AND SONORAN DESERTS (SOUTHWESTERN UNITED STATES) Amer. jour. sci., v.262, no.4 pp. 417-35, incl. illus., tables, 31 ref. April 1964 DLC Q1.A5

Comparison of 54 long profiles of pediments in the Mojave and Sonoran Deserts shows that even though individual pediments slightly concave upward, the expected correlation between the length of a pediment and its average slope could not be established. Neither variations in the size of the drainage basins tributary to the pediments nor differences in bedrock on which the pediments are cut, account

satisfactorily for the differences in slope. A more attractive explanation for most of the differences of slope is that they result from tectonic tilting or warping and/or from more than 1 cycle of pedimentation.

96. Yang, T.W. and C.H. Lowe CORRELATION OF MAJOR VEGETATION CLIMAXES WITH SOIL CHARACTERISTICS IN THE SONORAN DESERT Science, v.123, no. 3196 542, March 30, 1956. DLC Q1.S35

From an analysis of pertinent soil characteristics and their correlation with climax vegetation types of the Sonoran Desert, it is concluded that here, specifically, different soil attributes characterize, and are intimately associated with, distinctly different and major climax vegetation types existing under the same macroclimate.

97. Blissenbach, Erich GEOLOGY OF ALLUVIAL FANS IN SEMIARID REGIONS
Geol. Soc. Amer., Bull. v.65, no.2 pp. 175-190, incl.
illus., 31 ref. February 1954 DLC QE1.G2

An alluvial fan is a body of detrital sediments built up at a mountain base by a mountain stream. Bold relief is essential and moderately arid to semiarid climates are favorable for the development of fans. Depositing agents are sheet floods, stream floods, and streams. Compound alluvial fans result from lateral coalescence of single fans. Development of alluvial fans is affected by changes in the course of a cycle, varying base level, climatic changes, tectonic movements, and slumping of fan deposits. Telescoped or superimposed structure may be developed. Fan deposits are arkosic or graywacke. Sorting and roundness of particles range widely. The matrix is primary or secondary. In general alluvial-fan deposits are stratified. Channel cut-and-fill is pronounced. Individual strata in fans are up to 20 feet thick. Particles in stream deposits are imbricated. Talus-slope deposits at the apex of a fan and floodplain deposits at its base can be separated from those of an alluvial fan by particle sizes, angularity and orientation of fragments, sorting, and original dip of strata. Mudflow deposits in an alluvial fan indicate certain climatic conditions during its formation. Many ancient fan deposits may have escaped recognition because of the common misconception that fan deposits are necessarily unstratified, composed of angular fragments, poorly sorted, and without distinctive sedimentary structures.

98. Fletcher, Joel E. and W.P. Martin SOME EFFECTS OF ALGAE AND MOLDS IN THE RAIN-CRUST OF DESERT SOILS Ecology v.29, no.1 pp. 95-100, 1948 DLC QH540

An infestation of the rain-crust of some desert soils by algae and molds is described. Algae present were all Cyanophyceae of the genera: Nodularia, Microcoleus, Nostoc, and several members of the family Chroococcaceae. Molds identified by hyphas transfer to Czapeks' agar were Rhizopus, Mucor, and probably Botrytis. Removal and analyses of the Stabilized crust indicated an increase in silt and clay content, with a corresponding decrease in sand compared to soil immediately beneath. Increases as high as 300% in C and 400% in N occurred in crusts where microbial growth was extensive. The largest increases in nitrogen were crusts containing the N-fixing Nostoc. No Azotobacter were present in any of the crusts. It is believed that these invasions improve infiltration, decrease erosion, and aid in seeding establishment under rigorous desert conditions.

99. Reynolds, H.G. and G.E. Glendening MERRIAM KANGAROO RAT AS A FACTOR IN MESQUITE PROPAGATION ON SOUTHERN ARIZONA RANGELANDS Jour. range magmnt., v.2, no.4 1949 pp. 193-97 DLC SF85.J67

Mesquite (Prosopis spp.) beans are a favored food of the Merriam kangaroo rat (Dipodomys merriami merriami). That the rat is a factor in the spread of mesquite is shown by clusters of mesquite seedlings originating from surface caches made more or less at random in the home territory of the rat.

100. Pfefferkorn, Ignaz SONORA: A DESCRIPTION OF THE PROVINCE Translated and annotated by Theodore E. Treutlein Albuquerque, University of New Mexico Press, 1949 329 pp. DLC F1386.P353

Author has translated the 18th century German Jesuit priest's geographical, historical, and ethnological description of Sonora, Mexico. Chapter III discusses the mountain ranges, quebradas, climate, weather, mining, ranching, and agriculture. Chapters on useful plants and animals, and insects, are included. Manners, customs, and the habits of the Sonorans are discussed in detail along with the internal affairs of the various missions. A generalized map, vintage circa 1775 is included.

101. Marks, John Brady VEGETATION AND SOIL RELATIONS IN THE LOWER COLORADO DESERT Ecology, v.31, no.2 pp. 176-193, incl. illu., 1950 DLC QH540.E3

Plant communities in a desert area of s.w. Arizona and s.e. California are described and related to the texture and salt content of the substrate. Four physiographic provinces --- the valleys, the mesas, the bajadas, and the mountains --- are described with their characteristic soil types. In the valley 4 communities are described, dominated respectively by Prosopis juliflora, by Pluchea sericea and Tamarix gallica, by Atriplex spp., and by salt shrubs Allenrolfea occidentalis or Suaeda torreyana. Two sub-communities of the Prosopis community are described together with 2 societies related to soil textures within the Pluchea-Tamarix community. One association, the Larrea-Franseria, is described for the mesa, together with its subcommunities, and one community dominated by Fouquieria splendens and various cacti is described on the bajada. Soil samples collected under these communities were tested for moisture retention and for % of soluble salts. The Atriplex and Pluchea-Tamarix communities are the least saline in the valley; the Prosopis, the Suaeda and the Prosopis-Atriplex

communities are significantly more saline. The Prosopis-Suaeda community is significantly more saline than these; The Allenrolfea community is significantly the most saline of all. Moisture retention data for the plant communities show increasing moisture-holding capacity of soils indicated by the Acacia greggii and Coldenia palmeri, the Dalea emoryi and Opuntia leptocaulis, the Fourquieria and the Larrea-Atriplex communities.

102. Aldrich, D.G. and J.R. Buchanan PHOSPHORUS CONTENT OF SOILS AND THEIR PARENT ROCKS IN SOUTHERN CALIFORNIA Soil sci. v.77, no.5 May 1954 pp. 369-76 DLC S590.S6

A study has been made of the water-soluble, acid-soluble, and total phosphorus contents of 140 unfertilized soils in southern California. These 140 soils represent 47 different soil series and involve nine profile groups set up on the basis of topography, mode of formation, and age of degree of profile development. Deficient levels of water-soluble phosphorus and acid-soluble P obtained according to the Bingham and Truog procedures, respectively, were found in every profile group. Total P supplies of less than 300 ppm. also were found in every profile group. A highly significant correlation was found between acid-extractable phosphorus and total P when all the soils of the survey were involved. An insignificant correlation was obtained when the analysis was confined to individual profile groups. No correlation could be found between water-soluble and total P. Of the soil examined, 60% had higher total P values in the 1st foot than in the 2nd foot; this suggests that soil-forming factors associated with a downward movement of P are of minor importance in these soils. The phosphorus content of the parent rock materials from which the soils were derived appears to be the primary factor in determining the P content of soils in southern California.

103. Clayton, Richard DESERT ANIMALS OF THE SOUTHWEST: AN EASY GUIDE TO . . . ATR Enterprises, Box 2358, Prescott, Arizona 86301, 1972

A guide to Southwestern Desert animals with description, footprints, sketches, description of habitants and distribution maps. Includes, Bobcats, Rabbits, Bighorn Sheep, Deer, Pronghorns, Skunks, Squirrels, Fox, Raccoon, Ring-tail, Coyotes, Gophers, Mice, and Mountain Lions.

104. Bennett, Iven and Ronald A. Nelson THE NIGHTTIME INFLUENCE OF IRRIGATION UPON DESERT HUMIDITIES US Army Quartermaster Res. & Engrng. Cent., Natick, Mass., Tech. rept. EP-136, July 1960 46 pp., 13 ref. PB150 184: Order from LC mi \$3.30, ph \$7.80

Field observations made in and around the Yuma oasis during the summer of 1956 examined the role of irrigated farmland in modifying the nighttime humidity of desert air. Synoptic measurements of temperature, humidity and wind at standard height were taken in the desert and in various crops within the oasis. A moderate increase was observed in moisture content of the air in the oasis compared with desert air. The magnitude of the increase was related to the general moisture level of the two prevailing summer air-masses; with dry Pacific air the increase mounted to 15 to 20 F degrees in dewpoint, and with moist air from the Gulf of Mexico it was limited to 5 to 10 F degrees. Similar but smaller differences were noted between moist and dry cropland within the oasis. Advection of moist air from the oasis into the desert could not be sharply delimited quantitatively, but within the first few hundred yards from the edge of the oasis, advection diminished rapidly and seemed barely evident at one mile. Nighttime evaporation and small daytime storage of heat in the oasis soil, contrasted with negligible nighttime evaporation and large heat storage in the soil of the desert, combined to produce minimum daily temperatures 5 to 15 F degrees lower in the Oasis than in the adjoining desert.

105. Clements, Thomas D. GEOMORPHIC CLASSIFICATIONS OF DESERT TYPES Geol. soc. amer., bull., v.65, no.12, pt.2 pp. 1240-1241, Dec. 1954 (Abstract only) DLC QE1.G2

A geomorphic classification of types of desert topography has been developed in the hot, dry area of Southwestern United States. These types are distinctive and can be recognized in other hot deserts of the world and probably in the warm deserts as well. The classification is as follows: (1) playas, the flat or nearly flat, low part of an enclosed basin. Playas can be subdivided into (a) dry, (b) moist, (c) crystal body, (d) compound, and (e) lime-pan; (2) desert flats, the essentially flat surfaces **extending from the edges of the playa to the alluvial fans** or bajadas; (3) alluvial fans, the fan or cone-shaped deposits at the mouths of canyons; (4) bajadas, alluvial aprons resulting from the coalescing of alluvial fans; (5) bedrock surfaces, results of erosion, and subdivided into (a) pediments, (b) desert domes, and (c) hammadas; (6) dry washes, stream-formed, but occupied by streams only at rare intervals; (7) dunes, accumulations of wind blown sand; (8) badlands, soft deposits of

any type eroded into rugged topography by sudden, heavy, but infrequent rains; (9) regions bordering through-flowing streams, desert areas traversed by rivers rising in humid regions; (10) desert volcanics, Recent or Pleistocene volcanics occurring commonly in desert areas, although not related genetically to the desert; and (11) desert mountains, mountains separating or bordering desert basins.

106. Clements, Thomas et al A STUDY OF WINDBORNE SAND AND DUST IN DESERT AREAS U.S. Army Quartermaster Res. & Engrng. Center, Natick, Mass., Earth Sciences Div., Tech. Rept. ES-8, 1963 61 pp., 13 refs. DLC US30.A6194 no.8

Severe sand and dust storms occur at a rate of less than 2/yr. on the average in the desert areas of southwestern United States. Storm incidence is higher in desert areas disturbed by man's activities, such as agriculture or large-scale military maneuvers. During a storm, sand and dust in militarily significant amounts are carried a few miles at most, but generally only a few hundreds or thousands of feet. Wind-driven sand is carried mostly within 2 ft. of the ground, with 6 ft. as a maximum height in all but extremely high winds. Critical pick-up velocities of winds vary according to the type of desert surface, the grain size and coherency of the surface materials, and whether or not the surface has been disturbed artificially. In dune areas, winds of 10-15 mph will initiate movement, and on other sandy terrain, winds of 20 mph will be necessary for this. Fine materials on desert flats will be set in motion at 20-25 mph, and on alluvial fans and playas at 30-35 mph. No wind-blown material will be derived from desert pavements unless the surface has been broken, and on all other above-mentioned types, disturbing the surface will lower critical pick-up velocities by as much as 5 mph.

107. Clements, Thomas, Richard H. Merriam, et al A STUDY OF DESERT SURFACE CONDITIONS US Army Quartermaster Research and Engineering Center, Natick, Mass., Tech. rept. EP-53, April 1957 130 pp., 47 refs. AD 142 865; PB 140 373 Order from LC, mi \$6.30, ph \$19.80

An empirical classification of world representative desert surface types developed using field and laboratory techniques in the desert regions of southwestern United States.

Each of the principal types was encountered during the field investigations, and is represented both in the United States and foreign desert regions. On the basis of land forms and their associated surface characteristics, the classification recognizes the following types: (1) Playas, (2) desert flats, (3) bedrock fields, in three categories, (4) regions bordering through-flowing streams, (5) alluvial fans and bajadas, (6) dunes, (7) dry washes, (8) badlands, (9) volcanic cones and fields, and (10) desert mountains. The following surface materials were noted during the field research: salt, lime, clay, silt, sand, gravel, boulder, desert pavement, and bare rock. The greatest contrasts between the deserts of the US and those of the Eastern Hemisphere are found in the amounts and distribution of dune areas, fans and bajadas, and bedrock fields.

108. Cloudsley-Thompson, J.L. DESERT LIFE Oxford, Pergamon Press, 1965, 86 pp., incl. map DLC QH88.C49 1965

Fairly simple book which gives a discursive account of the different types of animal life able to survive desert conditions. The first chapter attempts a definition of desert and semi-desert in terms of average annual rainfall and points to where the world's major deserts are situated. Brief details are given of the climatic characteristics of desert areas while considering rainfall, humidity, wind and microclimates. Climates within animal burrows briefly mentioned, also. Soils, vegetation, Invertebrate animals, vertebrates and aspects of ecology and development.

109. Bailey, Harry P. CLIMATE OF SOUTHERN CALIFORNIA Berkely, Univ. of California, Press, 1966 87 pp., incl. illus., tables, charts DLC, DAS, M82.1/794 B154c1 DLC QC984.C2B3

Describes the geographic setting, land forms and airflow followed by an illustrated discussion of the S climatic regions: maritime fringe, intermediate valley, transition and mountain climates, and the high and low desert climates. Types of clouds, smog, and smoke are illustrated in color. Weather types -- including Santa Ana Winds and winter air from the sea, and summer circulation -- are described. Weather types at LA related to wind direction and season are shown in a chart. Fire, floods, droughts and smog are treated as problems in applied climatology with special emphasis on the decrease of hood-making vapors and the smog problem.

110. Ehlen, Judy and Frand Barnett SURFACE MATERIALS AND TERRAIN FEATURES OF YUMA PROVING GROUND PORTION OF STOVAL, AZ QUADRANGLE Overprint on U.S.G.S. 1:62500 Series, US Army Engineer Topographic Labs, Fort Belvoir, Va., May 1973

Surface materials and bedrock types of northwestern portion (approx. 33 sq. mi.) of Stoval Quadrangle, prepared for the inventory.

111. Barnett, Frank SURFACE MATERIALS AND TERRAIN FEATURES OF YUMA PROVING GROUND PORTION OF PICACHO, AZ-CA QUADRANGLE Overprint on U.S.G.S. 1:62500 series, US Army Engineer Topographic Labs, Fort Belvoir, Va., February 1973

Surface materials and bedrock types of eastern third of Picacho quadrangle, prepared for the inventory.

112. McDonald, James E. ANNUAL AND SEASONAL PERSISTENCE OF PRECIPITATION IN ARIZONA Amer. meteorol. soc., bull., v.41, no.2 106, Feb. 1960 DLC QC851.A6

A series of precipitation autocorrelations were carried out to remove the suspicion that Nevada atomic bomb testing was interfering with local precipitation patterns. Data used from selected long-record Arizona Weather Bureau stations for both six month and twelve month lag periods. The results are discussed and tabulated.

113. Burnham, C. Wayne METALLOGENIC PROVINCES OF THE SOUTHWESTERN UNITED STATES AND NOTRHERN MEXICO New Mexico Bureau of Mines and Mineral Resources, bull. 65 76 pp., incl. illu., tables, 29 refs. 1959 DLC TN24.N6A232

Some of the metallogenic provinces of Southwestern United States and Northern Mexico are defined by the geographic distribution of sulfophile trace elements in more than 500 samples of chalcopyrite and sphalerite from 172 mining districts. Maps that show the geographic distribution of Sn, Ag, and the "combined metal content" in chalcopyrite, and of Ag and the "combined metal contene" in sphalerite reveal 3 major belts of high trace-element content in the Southwest. These belts, here called the Eastern, Central, and Western metallogenic belts, are consistent in trend and position with a beltlike distribution of the major ore deposits of Cu, Au, Ag, and other metals. However,

the deposits of a given metal tend to be concentrated in certain segments of the metallogenic belts; consequently, the metallogenic provinces, in the ordinary sense, are merely component parts of the larger beltlike features. The metallogenic belts are generally consistent in position and trend with the major tectonic features, although they do not appear to be closely related in time. It is suggested that both the metallogenic belts and the major tectonic features are the effects of a more fundamental cause, which perhaps is a combination of compositional heterogeneities and associated physical discontinuities in the deep-seated source of regions of the ores.

114. Miller, Fred Key STRUCTURE AND PETROLOGY OF THE SOUTHERN HALF OF THE PLOMOSA MOUNTAINS, YUMA COUNTY, ARIZONA Stanford University, Ph.D. thesis, 1966 Order from: University

Microfilms, Ann Arbor, Mich., Order No. 66-14,698 173 pp.
mi \$3.00, ph \$8.00

The Plomosa Mountains are a low but steep, north-south trending range in western Yuma County, Arizona, about 30 miles due east of Blythe, California. Five formations are distinguished, of which the upper three have striking similarities to the Supai Formation, Coconino Sandstone, and the Kaibab Limestone. Interbedded maroon mudstone, sandstone and pebble conglomerate of Mesozoic (?) age are present at several localities in the Plomosa Mountains. The age of these rocks is doubtful because they are unfossiliferous and nowhere in contact with the Paleozoic rocks. Three plutons of quartz monzonite intrude the Mesozoic (?) section and older rocks. Dikes and stocks of leucocratic dacitic or andesitic porphyry were emplaced at a slightly later time. Unconformably overlying all other rocks except the Tertiary and Quaternary (?) volcanics is a sequence of upper Mesozoic or lower Tertiary conglomerate, gray-wacke, and siltstone more than 11,000 feet thick. Tertiary flows, tuffs, and plugs of rhyolitic, dacitic, and andesitic composition unconformably overlie and protrude through all older rocks. Flat-lying olivine basalts with minor tuffaceous material overlie all other rocks except the recent alluvium. Normal and reverse faults trend east-northeast and approximately north. They cut the Precambrian (?) and Paleozoic metamorphic and sedimentary rocks and Mesozoic (?) intrusives, but cannot with certainty be traced into any younger rocks. Thrust faults, which in general strike about due north and have easterly dips less than 15 degrees, cut the conglomerate-gray-wacke-siltstone sequence and all older rocks.

115. Bryson, Reid a. and William P. Lowry SYNOPTIC CLIMATOLOGY OF
THE ARIZONA SUMMER MONSOON Wisconsin University Dept. of
Meteorol., Scient. rept. no.1, April 1955 25 pp., 21 ref.
Also in: Amer. meteorol. soc., bull., v.36, no.7 pp. 329-
339, Sept. 1955 DLC QC851.A6

Using the percent of climatological stations reporting rains as a measure of the raininess of a particular day in Arizona, a large increase in rainfall within a few days is found to occur about July 1 in most Arizona summers. By means of flow charts, upper air sequences, mean soundings, and diurnal temperature ranges, this increase is shown to be the result of a rather sharp transition from one dominant air mass to another over Arizona. The occurrence appears to be related to index, and a hemispherical singularity also appears to be related to the phenomenon.

116. Smith, Harlan J. and Richard E. McCrosky ASTRONOMICAL OBSERVING CONDITIONS IN THE SOUTHWEST Harvard Univ. Observatory, Contract N5ORI-07647, unnumbered rept., Feb. 1953
24 pp. DWB

Ignoring other factors contributing to good or bad astronomical observing conditions (especially for meteor observation and photography), the authors have made a detailed study of nighttime cloud cover frequency over the Southwest United States to determine the most suitable spot for an observatory. The Southeastern States were excluded because of generally cloudy summers and the far West and Northern States because of cloudy winters. Great local differences appear on the isarithm charts drawn for Southern California, Arizona, and New Mexico (based on synoptic weather data for 20 stations for 1939-1946). The region within 100 mi around Yuma, Arizona is shown to be the best on the average, with 6.8 hours per night clear (less than, or equal to .1 cirrus). Transparency or visibility data were not available or considered unusable for the purpose of this study.

117. Paylore, Patricia A BIBLIOGRAPHY OF ARID-LANDS BIBLIOGRAPHIES
Arizona University, Tucson Institute of Arid Lands Res.
USA-NLABS-TR-68-27-ES-34, Oct. 1967 80 pp. AD 663 843

Technical report brings together arid-lands bibliographies from the several thousand citations in the Pertinent Publications sections of subject chapters comprising the compendium, An Inventory of Geographical Research on World Desert Environments (US Army Natic Laboratories contract DA49-092-ARO-71), adds appropriate bibliographies from other sources, and indexes the total number by geographic area and by subject. Of the nearly 6,000 references ana-

lyzed for this purpose, 269 were selected from Inventory Pertinent Publications, and combined with 93 additional citations for a total of 362. Annotations modified or constructed to emphasize bibliographical importance of the reference.

118. Cooley, M.E. (compiler) ARIZONA HIGHWAY GEOLOGIC MAP Tucson, Arizona Geological Society scale -- 1:1,000,000 text, 1967

Text includes an inset physiographic map with accompanying illustrations of features, and maps showing stages of the geological evolution of Arizona. Although exposed rocks record only about half of geological time, collectively they comprise one of the most complete sections in the North American continent. The text presents the geologic history from Precambrian through Quaternary time.

119. Court, A. DURATION OF VERY HOT TEMPERATURES Amer. meteorol. soc., bull., v.33, no.4 pp. 140-49 1952 DLC QC851.A6

Maximum temperatures on very hot days in hot-desert areas are similar in duration and time of occurrence to maximums on cooler days; they occur around 3 hours after noon, and the temperature (as measured to the nearest whole degree by standard thermometers) remains at the maximum for about 2 hours. These findings are based on analysis of the differences between hourly temperatures and the maximum of the day, on days when the maximum was 100 degrees F or more, during 2 summers in 2 desert areas of the world.

120. Denny, Charles S. FANS AND PEDIMENTS Amer. jour. sci., v.256, no.2 pp. 81-105, incl. illus., refs. 1967 DLC Q1.A5

Washes in desert areas probably increase in discharge downstream only in mountains; on piedmonts, discharge may decrease rapidly downfan. Using the open-system concept, a piedmont may be considered as approaching a steady state when the rate at which material moves from piedmont to playa or flood plain. To maintain such a steady state requires broad areas of piedmont where erosion is the dominant process. Whether these areas of erosion are areas of more or less bare rock-pediments or whether they are abandoned segments of fans depends upon the geometry of highland and lowland. Large highlands and small lowlands favor complex fans where half the surface area may no longer receive sediment but be subject to erosion. Broad lowlands and small highlands favor extensive pediments.

121. Jackman, Albert H. HANDBOOK OF YUMA ENVIRONMENT US Army
Quartermaster Research and Engineering Center, Natick, Mass.
Environmental Protection Branch rept. no.200, February 1953
60 pp., 11 ref. PB 146 815 Order from LC ml \$3.60
ph \$9.30

Heat and drought are the major climatic controls over desert testing in the Yuma Test Area. About one-half the days of the year have maximum temperatures of 90 degrees F or above, and nearly one-third the days have maximum temperatures of 100 degrees F or over. High temperatures and heat stress problems are most frequent from May through September. Winters (December through February) are cool. The low rainfall of the Yuma region is indicated by its mean annual precipitation of 3.38 inches. Moist air, however, sometimes moves over the region from the Gulf of California bringing fairly high humidities, particularly noticeable during July and August. Other meteorological factors considered in this report include dew points, wind speeds, and cloud cover. The topographic arrangement or form ranges from low, flat bottomlands with practically no slope gradient to rugged mountain terrain with characteristic gradients of 20 to 45 degrees. Most of the area has a sparse vegetation cover of low shrubs, with growths of small thorny trees in the washes and other drainage channels. The smaller shrubs are generally stiff and woody; certain species of cactus present a special protection problem due to their spines. Only in bottomlands where the water table is near the surface is there a dense shrub or tree growth consisting of mesquite, tamarisk (salt cedar), arrowweed, willows, or cottonwoods. Where there is surface water standing most of the year, as in the river overflow areas, there are dense growths of cattails and other semi-aquatic plants.

122. American Society of Civil Engineers Task Committee on Preparation of Sedimentation Manual SEDIMENT TRANSPORTATION
MECHANICS: WIND EROSION AND TRANSPORTATION Amer. soc.
civil engineers, v.92, jour. hydraulics dif., HY2(1)
pp. 267-287, 61 ref. DLC TCl.A39

The transport of soil material by wind is a special case of the broader field of the transport of solids by fluids. Certain fundamental and relatively great differences exist, however, between the transport of material by wind as compared to its transport by water. For example, soil as it is exposed to wind erosion is made up of solid, liquid, and gaseous components, whereas soil exposed to water

erosion is made up principally of solid and liquid components. The greatest fundamental difference between air and water transportation, however, is associated with the difference in density of the fluid media. Such variables as wind, surface topography, soil, and surface effects must be studied to gain a picture of the wind erosion problem. Beginning with the von Karman-Prandtl equation, this report (when finally revised, the material will be part of the proposed Report on Sedimentation Engineering) examines the existing knowledge in this area of sediment transportation mechanics. (See no.43 for additional discussion on the manual.)

123. MacDougal, D.T. BOTANICAL FEATURES OF NORTH AMERICAN DESERTS
Carnegie Inst. Wash. pub. no.99, 1908 pp. 35-40.

Early and generalized review of the vegetation of North American deserts including portions of Chihuahua, Sonora and Baja California. Discussions include the vegetation of the Sand Hills of Chihuahua, the Colorado River delta, the San Felipe area, the Baja California and Sonoran deserts. Superseded in detail and accuracy by several later, particularly Shreve and Wiggins.

124. Dice, Lee R. THE SONORAN BIOTIC PROVINCE Ecology, v.20, no.2
April 1939 pp. 118-29, 22 ref., map DLC QH540.E3

The province is distinguished by its assemblage of species and races of plants and animals. Many of the peculiar Sonoran races and species of amphibians, reptiles and mammals have probably differentiated in the province, due evidently to the occurrence there of very distant types of environmental conditions combined with a considerable amount of local isolation. Province is also distinguished as an important physiographic province, climatic province, and as a vegetation climax.

125. Shreve, Forrest and T.D. Mallery THE RELATION OF CALICHE TO
DESERT PLANTS Soil sci., v.35, no.2 Feb. 1933 pp. 99-
113, 8 ref. DLC S590.S6

Over extended areas of SW United States the soil is impregnated with faintly stratified layers of calcareous hardpan of varying thickness, or filled with hard nodules and amorphous masses of highly calcareous material. The rather distinctive type known to be of wide occurrence in Arizona, New Mexico, and Sonora, is designated by the Spanish name,

caliche. Object of this study was to investigate some of the physical properties of caliche with reference to the movements and availability of water in the soil, and to determine the influence exerted on the growth of a common desert shrub by varying quantities of the material of which caliche is composed. Caliche material used was taken from the Tucson area. Discussion of the occurrence, composition, and hypotheses on the formation of caliche included.

126. Henshaw, Paul GEOLOGY AND MINERAL DEPOSITS OF THE CARGO MUCHACHO MOUNTAINS, IMPERIAL COUNTY, CALIFORNIA Calif.
 jour. mines & geol., v.38, no.2 pp. 147-196 April 1942
 DLC QE89.A2

A study of the Cargo Muchacho Mountains, defined as a small range, including outlying hills in the northern half of the Yuma quadrangle (California-Arizona), presents the first account of the geology of southeasternmost California. In these mountains, pre-Mesozoic kyanite schist and arkosite are intruded by a series of granitoid rocks probably Mesozoic in age. The two youngest rocks of this series were formed by granitization of arkosite. Andesite dikes of minor importance probably intruded the area in Tertiary time. Remnants of a once extensive flow of olivine basalt cover a few outlying hills. Alluvial deposits of three distinct ages occur in the area. Two of these, prebasalt in age, offer evidence that the Colorado River formerly flowed through the region. The Cargo Muchacho Mts. constitute an important gold mining district. The occurrence of the ore is shown to have been controlled by regional structure. The ore deposits are mesothermal and are locally characterized by extreme alteration of the wall rock. Kyanite and sericite also mined in the district.

127. Williams, Llewelyn CLIMATOLOGICAL CONDITIONS FAVORING OCCURRENCE OF HIGH TEMPERATURES AT YUMA PROVING GROUND, ARIZONA
 US Army Quartermaster Res. & Engrng. Center, Natick, Mass.,
 Earth Sci. Div., ES 28, Jan. 1967 10 pp. DAS, M(055)
 U586te; DDC AD648 016 also in Annals of the Assoc. of Am.
 Geogr., v.57, no.3 Sept.1967 pp. 579-92

Meteorological observations taken by the US Army Met. Team at the Yuma Proving Ground, Arizona, provide some basic lower and upper limits to vertical solar and total sky radiation, ground-surface temperature, dew-point temperature, wind speed, and wind direction during occurrence of

high ambient air temperature. However, even the more favorable combinations of these surface conditions do not provide an adequate explanation for occurrence of extreme temperatures at Yuma. The apparent key is the temperature of the air layer between 850 and 650 mbs. If this layer is warm, and a mechanism exists for bringing the air down to the surface, high ambient air temperatures exist. The mechanism may be the vertical exchange induced by the afternoon convection, or it may be the foehn effect brought about by the synoptic pressure pattern.

128. Bennett, Iven THE YUMA TEST STATION, ARIZONA, HOURLY AND DAILY INSOLATION RECORD, 1951-1962 US Army Quartermaster Res. and Engrng. Cent., Natic, Mass., Earth Sci. Div., Tech. rept. ES-15, March 1965 49 pp., incl. illus., tables DDC AD 462 122 Also his: YUMA, ARIZONA, SOLAR RADIATION RECORD Sun at work (Tempe, Ariz.) v.11, no.3 pp. 7-10 1966 DAS

Notick

Approximately 10 yrs. of hourly and daily insolation data for the US Army Yuma Test Station, Arizona are summarized in tabular and graphical form. Frequency distributions, total, and means of hourly and daily insolation, are given for each month of the year. Information is presented concerning the efficiency of the Eppley pyrhelimeter, and of the adequacy of visual data integration and reduction. As expected from the latitude of the station (32 degrees 50'N) and the low incidence of cloud cover, insolation values are high through much of the year. From March through October 30% or more of the hours receive at least 60 lys, and from April through August, 20% of the hours receive 80 lys or more. Intensities of 100 lys or more occur from April through July, with the maximum during May when 3% of the 3 hrs centered about True Solar Noon reach 100 lys or more. Low values occur primarily during early morning, or late afternoon hours. Values less than 20 lys do not occur at midday except on occasional days in winter and during the summer rainy period of late June and July. Daily values also run high. Daily totals of less than 100 lys occur only in winter and then infrequently. From April through September only 1.7% of the days of these same months receive 700 lys or more. The second paper is a brief summary of the Technical Report.

129. Nelson, Ronald A. COMPARISON OF YUMA TEST STATION AND YUMA WEATHER BUREAU METEOROLOGICAL RECORDS, 1952-1956 US Quartermaster Res. & Engrng. Center, Environmental Protection Res. Div., Res. Study Rept. RER-16, November 1957, 23 pp., incl. illus., tables, 8 ref. DWB M86 U585re; AD 150 083

A comparison of meteorological records from Yuma Test Station

and Yuma City Weather Bureau, 17 miles apart, has been prepared to show graphically the differences and/or similarities that exist between the two meteorological stations. Tables and graphs were prepared for the various climatic elements considered in the report and a brief analysis of each may be found in the text. In general, there are few significant differences between the two stations for any of the climatic elements considered. Yuma Weather Bureau reports consistently more extreme maximum and minimum temperatures but the difference is usually not more than 1 or 2 Fahrenheit degrees. Precipitation, though irregular, averaged slightly higher at Yuma Test Station. The differences which do occur between the two stations are not great enough to cause concern on the part of testing agencies who utilize Yuma Test Station but depend upon Yuma Weather Bureau records for long-period normal values for the various climatological factors.

130. Green, Christine R. and William D. Sellers (eds.) ARIZONA CLIMATE Rev. ed. Arizona, Univ. Inst. Atmos. Physics, Tucson, University of Arizona Press, 1964 503 pp. DLC QC984.A6A82

A long, detailed description of the climate of Arizona considers the physical features, precipitation, temperature, relative humidity and temperature-humidity index, surface winds, cloudiness, evaporation, and climatographies for 93 stations. Data for each station is provided. Stations within the Sonoran Desert region include Yuma, Yuma Valley, Yuma Citrus Station, Wellton, Mohawk, Dateland, Sentinel, Gila Bend, Ajo, Silverbell, Tucson, Maricopa, Casa Grande, and Red Rock.

131. Ives, Ronald L. CLIMATE OF THE SONORAN DESERT REGION Assoc. Amer. Geographers, ann., v.39, no.3 pp. 143-84, incl. maps, graphs, September 1949, refs. DLC G3.A7

A summary of previous work of others such as Russell, Sykes and Contreras Arias, the official weather services of the U.S. and Mexico, augmented and checked by data collected in the field from 1928-1947. The Sonoran Desert in this study is bounded by latitudes 20 and 38 N, and longitudes 104 and 121 W. This area includes all or part of California, Nevada, Utah, Colorado, Arizona, New Mexico, Texas, and the Mexican states of Sonora, Chihuahua, Baja California, Durango, Nayarit, and Jalisco. It is concluded that this region is a true desert, and the causes of the aridity are: (1) dessication of the air incoming from the north, west, and east by passage over relatively high mountain barriers, (2) dessication of air incoming and in place, by convective uplift, mixing with subsiding "Horse Latitude" air, and subsistence of the mixture, (3) heating of air incoming from the south, so that relative humidity is greatly reduced, (4) southward location of the area

relative to the mean position of the Polar Front, and overall weakness of the "Sonoran Monsoon", and its inefficiency as a rain generator. This is due in large part to the unfavorable location of physiographic features with respect to regional pressure and wind pattern.

132. Brown, G.W. Jr. (ed) DESERT BIOLOGY New York, Academic Press, 1968 V.1 575 pp.

Treatise dealing with the biological aspects of the world's deserts. Volume 1 focuses on the forces causing desert and arid regions, the evolution of desert plants, water economy, desert ecology and limnology, poisons, desert animals, and the adaptation and behavior of plants, reptiles, amphibia, birds, fish and mammals (including man).

133. Hunt, C.B. DESERT VARNISH Science, v.120, no.3109 pp. 183-184, July 30, 1954 3 ref. DLC Q1.S35

Desert varnish is a blackish or brownish stain of iron and manganese oxides on rock surfaces. As the name implies, desert varnish is best developed, or at least most conspicuous, in arid or semi-arid regions; but similar stains also occur in humid regions. Origins and nature of desert varnish on the Colorado Plateaus were formed during pluvial periods, and as such, can be useful in deciphering the stratigraphy of late Pleistocene and Recent deposits and events.

134. Kovach, Robert L., Calrence R. Allen and Frank Press GEOPHYSICAL INVESTIGATIONS IN THE COLORADO DELTA REGION Jour. geophys. res., v.67, no.7 pp. 2845-71, incl. tables, graphs, maps, 31 ref. July 1962 DLC QC811.J6

The combined approach of gravity and seismic refraction techniques was used to determine depths of the Cenozoic section and fault patterns of Colorado delta region. Bouguer gravity anomalies range from -10 to -88 mgal with respect to the International Ellipsoid, and the trend of isogal contours is northwesterly. In the center of the basin, depths to basement estimated from gravity data are less than known minimum depths determined from seismic refraction profiles. This discrepancy suggests density complexities within deeper parts of the stratigraphic section, and interpretation supported by sparse measurements from well samples. Local isostatic compensation may also contribute to the discrepancy but is not thought to be the major cause. Measured seismic velocities ranged from 5650, to 20,000 ft/sec, and several consistent velocity zones were widespread above the pre-Tertiary basement. The indicated depths to basement varied from 2200 feet to at least

15,400 feet, the greatest depth being near the international border. Many members of the San Andreas fault system are well delineated by gravity and seismic data, including the Elsinore and San Jacinto faults and a fault beneath the Sand Hills. Of these, the San Jacinto fault appears to be the most continuous through the delta region, but all appear to be an echelon to the trend of the San Andreas fault system as a whole.

135. US Army Electronic Proving Ground, Ft. Huachuca, Arizona
ATMOSPHERIC ELECTRICAL REFRACTIVITY, GILA BEND, ARIZONA
MAY 1-28, 1964 Its Report A-600009-2399, June 15, 1964
31 pp. (mostly tables) DWB M(051) U581r

Report presents the atmospheric electrical refractivity data as obtained from the reduction of radiosonde and wiresonde observations of temperature, pressure and relative humidity in support of electromagnetic environmental testing. The computational procedure is explained.

136. Cloudsley-Thompson, J.L. and M.J. Chadwick LIFE IN DESERTS
Philadelphia, Dufour Editions, 1964 218 pp., incl. illu.,
tables, graphs, ref. DLC QH88.C5

Adaptation to arid conditions by living organisms has taken many forms and is not restricted to a few small, isolated groups of organisms. One of the most fascinating aspects of the study of desert life is in the degree of parallel or convergent evolution that has taken place providing many common characteristics between unrelated groups. For this reason, the objective of this book was not to give an account of each desert region of the world in turn or to treat desert organisms according to a detailed taxonomic arrangement. Rather stress is placed on the mechanisms of adaptation as evidenced by the varied and diverse organisms of the desert environment.

137. Dodd, Arthur V. and Harry S. McPhilimy YUMA SUMMER MICRO-
CLIMATE US Quartermaster Res. & Engrng. Cent., Environmental Protection Res. Div., Tech. Rept. EP-120, Natick, Mass. November, 1959 34 pp. DWB

Data for July and August 1956 for 3 sites (sandy plain, desert pavement, and rocky hilltop) were selected for analysis from 14 months of micrometeorological observations at 6 sites near Yuma. Temperature was measured

every 10 minutes at 10 levels from 25 cm below to 200 cm above the ground surface, wind speed at 5 ft above the ground, Included in report are graphs of mean hourly temperature data for each hour and at each of the 10 levels, as well as cumulative frequency distributions of temperature at 4 selected levels, and mean hourly 5-ft wind speeds. Also given are temperature gradients representative of conditions of strong incoming and outgoing radiation and of periods of high and low humidity, and data on the frequency of temperature inversions, by wind-speed classes, as well as hourly radiation totals (for one site, sandy plains). Differences in the character of the vertical temperature regimes and the diurnal regime of wind speed at the 3 sites are discussed.

138. Allison, Edwin C. GEOLOGY OF AREAS BORDERING GULF OF CALIFORNIA In: Andel, Tjeerd H. van, and George G. Shor, Jr., (eds), Marine geology of the Gulf of California; a symposium Tulsa, Okla., American Association of Petroleum Geologists, Memoire 3, 1964 pp. 3-29, incl. table, maps, 154 ref. DLC QE39.A5

The Gulf of California is an integral part of the North American Cordilleran segment located between latitudes 18 and 35 N -- the trans-Mexico volcanic belt of central Mexico and the Transverse Ranges of Southern California, respectively. Distribution of gross rock types and of major structures within these limits exhibit a characteristically Cordilleran N-NW structural grain. That structural grain appears to have persisted since the Paleozoic era, although the evidence is obscured by the effects of intense late Mesozoic orogenic disturbances. The Transverse Ranges structural trend, which terminates the Cordilleran segment that includes the Gulf, also appears to have an ancient geologic history. The demonstrable history of the Gulf begins with the Miocene, although redeposited older marine fossils and Eocene outcrops at the head of the trough in which the Gulf is situated suggest a possible earlier origin as one of the possible explanations for their anomalous occurrences. Geologic information available at present does not permit a definitive choice between the several hypotheses for the origin of the Gulf, although recent geophysical work has ruled out the earlier widely accepted graben theory. A section devoted to the geology of the Sonoran Desert region is included.

139. Ohman, Howard L. and Richard L. Pratt THE DAYTIME INFLUENCE OF IRRIGATION UPON DESERT HUMIDITIES US Quartermaster Res. & Development Cent., Environmental Protection Div., Tech. rept. EP-35 30 pp., 14 ref. May 1956 DWB

To determine the extent to which atmospheric humidities in the surface layer of the atmosphere are influenced by irrigation, the authors analyzed the distribution of dew point within the vicinity of the irrigated land near Yuma, Arizona during August 3-13, 1954. Moisture characteristics of the air before and after passage over irrigated field, humidity distribution in crop lands, and the variation in humidity over a distance of 20 miles extending from the desert south of Yuma -- the All-American Canal on the north -- were analyzed. It was found that (1) transpiration and evaporation causes the dew point to increase 6 to 8 degrees F and the temperature to decrease 4 to 6 degrees F at height of 3 feet when wind speeds are less than 10 mph within the immediate area of cultivation, (2) the effect is limited at crop height levels to about 100 feet from the moisture source when wind speeds are less than 10 mph, (3) within the irrigated land the areal distribution of crop development is a strong index to the distribution of humidity and (4) irrigation exerts a negligible influence upon atmospheric humidities in the area examined. Tables giving data and maps showing the dew point distribution in southwestern United States, dew point values at Colorado River Control (Yuma, Arizona) and the location of weather sites and a weather map of western US for 7 August 1954 are presented.

140. Christopher, W.C. SOME ASPECTS OF THE YUMA ENVIRONMENT Institute of Environmental Sciences, San Diego, Ca. Proceedings of the annual technical meeting, Mt. Prospect, Illinois, 1966 pp. 321-23 DAS 606 I59 pro 1966

A discussion of solar radiation, ground radiation and of ambient temperature which contribute to thermal stresses of test items at the Yuma, Arizona Proving Ground. Plotted 8 year (1952-1959) monthly averages of solar radiation, temperature and relative humidity; and of average daily (1000 thru 1600 hrs) insolation and temperature show the following; Maximum solar radiation occurs during May and June, diminishing slightly in July and falling off rapidly in August and September. Maximum temperatures, both ground and ambient, are generally attained in June, July, and August. May and June are the driest months. Peak solar radiation occurs at approximately 1300 hrs.,

peak ground temperature lags approximately 1 hr. and ambient temperature keeps rising until approximately 1600 hrs. Temperature summary for 1956-1960 shows that the greatest number of hours of 105 degrees or better is approximately 6 hours in May, 87 in June, 118 in July, 83 in August, and 40 in September. The nature of the Army items being tested (vehicles, ammunition, mines) is discussed. Temperature conditions for cartridge, 105-MM, AP-T, stored in shipping containers and exposed directly to solar radiation, August 21, 1961, the average daily temperature cycle during emplacement and storage of a mine are shown graphically.

141. Metzger, D.G. THE BOUSE FORMATION (PLIOCENE) OF THE PARKER-BLYTHE-CIBOLA AREA, ARIZONA AND CALIFORNIA US Geol. Survey, Prof. Paper 600-D, pp. D126-D136, incl. illus., table 1968 DLC QE 75.P9

A marine to brackish-water deposit of Pliocene age, older than the Pliocene and Quaternary deposits of the Colorado River in the Parker-Blythe-Cibola area Arizona and California, is here named the Bouse Formation. Primarily a subsurface formation, it is composed of a basal limestone and interbedded clay, silt, and sand, and a tufa. The greatest known subsurface thickness is 767 feet, whereas the greatest exposed thickness is 215 feet. The Bouse Formation contains foraminifers, mollusks, ostracodes, charophytes and barnacles, although the number of species is small. The Bouse Formation was deposited in an embayment of the Gulf of California; however, the limited faunas prevent a correlation of the Bouse with marine deposits of the Imperial Valley.

142. Murphy, Charles H. and Gerlad V. Bull IONOSPHERIC WINDS OVER YUMA, ARIZONA, MEASURED BY GUN-LAUNCHED PROJECTILES Jour. geophys. res., v.73, no.9 pp. 3005-3015, incl. illus., tables, 17 ref. May 1, 1968 DLC QC811.J6

The newly installed 420-mm smoothbore gun at Yuma Proving Ground, Arizona, is described with its associated ground instrumentation. Twenty-four projectiles, carrying liquid trimethyl aluminum, have been used to measure ionospheric winds through the creation of luminous trails. Analysis shows the presence of quite large easterlies at 110 km and a general descent of the wind patterns through the night. Harmonic analysis of the wind components at fixed altitude shows periodic components 2 to 5 times larger than the mean components and predominate periods of 10-12

hours. Seventy-five percent of the trails showed a characteristic clockwise rotation of the velocity vector. The absence of these phenomena at Barbados and the observation of counterclockwise rotation of trails over Argentina show the need for a theory to explain this behavior and its dependence on latitude and the Earth's rotation.

143. Cameron, Roy E. ABUNDANCE OF MICROFLORA IN SOILS OF DESERT REGIONS California Institute of Technology, Jet Propulsion Lab., Tech. rept. 32-1378, May 15, 1969 16 pp., incl. illus., tables, 39 ref. N69 25018

Surface soils were collected by aseptic techniques from cold, polar, hot, volcanic, and high mountain deserts, and were analyzed for physical, chemical, and microbiological properties. Soils showed a wide range of properties but were generally greyish, yellowish, or brownish sands, low in organic matter and cation exchange capacity. There were detectable concentrations of water-soluble ions, and pH values above 7.0, except in volcanic areas. Total microbial abundance ranged from zero (undetectable) to

8
10 /gm of soil. Aerobic and microaerophilic bacteria were most abundant, followed by algae and molds. The anaerobic bacteria were generally least abundant or undetectable. Predominant microflora included Bacillus spp., soil diphtheroids, Schizothrix spp. and other oscillatoriid blue-green algae, Streptomyces spp., Penicillium spp., and Aspergillus spp.

144. Carr, J.A. THE RAINS OVER ARIZONA, AUGUST 26 to 29, 1951
Monthly weather rev., v.79, no.8 pp. 163-67, Aug. 1951
DLC QC 983.A2

Confluence of two streams of air having long fetch over warm water areas, one from the Gulf of Mexico and one from the west coast of Mexico and Gulf of California, produced some of the heaviest rains ever recorded in Arizona during August. On the 26th, this air, which according to soundings at Phoenix, was unusually moist in the lower levels (less than 3 km), produced showers and thunderstorms over southern Arizona and later steady rains and unusually cool weather over most of Arizona, ending a prolonged drought. An upper anticyclone over Texas and New Mexico, which built up during a prolonged hot spell, is thought to be responsible for the easterly flow of Gulf air across Mexico and southerly flow into Arizona. There, upslope motion and convectional heating set off the thunderstorms which cooled the air in the lower levels 20 - 30 degrees F and provided the convergence necessary for later rains. The cycle ended with the approach of an upper trough over the northwest,

bringing air having a fetch over the cold water of the west coast and thus becoming more stable as it entered the relatively hot valleys of the interior southwest. At Phoenix the 5.33 inches in August 1951 was a record for 56-year history of station. Payson broke a 43-year record with 10.38 inches.

145. Green, Christine R. PROBABILITIES OF DROUGHT AND RAINY PERIODS FOR SELECTED POINTS IN THE SOUTHWESTERN UNITED STATES
University of Arizona, Institute of Atmospheric Physics,
Tech. repts. on the meteorology and climatology of arid regions, no.8 January 31, 1960 4 pp. + 23 plates
DLC QC993.7.T4

Report presents the results of an investigation of rainfall and drought probabilities in the southwestern United States. Daily weather records for 10 weather stations (including Yuma and Parker, Arizona, in the Sonoran Desert area) were used to compute the empirical probabilities that droughts of 5, 10, 20 or 25 days or rainy periods of 3,5,10 or 15 days will start on any day between April 15 and September 15. The results are presented graphically in smoothed form in 24 figures.

146. Dunbier, Roger THE SONORAN DESERT. ITS GEOGRAPHY, ECONOMY, AND PEOPLE Tucson, University of Arizona Press, 1968
426 pp., incl. illus., maps, refs. \$10.00 DLC GB613.D8

Presents an extensive geographical, social, and economic study of a desert region isolated from core areas of both the US and Mexico. With a rainfall rarely exceeding 12 inches and high temperatures, this area relies almost completely on stream flow and underground sources for essential water supplies. The historical and ethnic background of the region is described and contrast between the 2 national economies are outlined, noting conflicts for both land and water on each side of the border. The effect of irrigation on population densities is considered. The overall pattern of rainfall, temperature, stream flow, irrigated acreage, and crop acreage for the entire desert is summarized in a series of tables to about 1960; basic comparable area data are not available for subsequent years.

147. Kniffen, F.B. LOWER CALIFORNIAN STUDIES IV. THE NATURAL
LANDSCAPE OF THE COLORADO DELTA Calif. Univ., Pub. in
geogr., v.5 pp.149-244, 1932 DLC G58.C3; GB126.C2K5

A detailed discussion of the tectonic framework of the Colorado Delta area and its geomorphic features, plus a section on the Salton Sea and Laguna Salada is provided. Report is one of the most complete geographic and geologic works on this particular area. Approximately 30 photographs illustrate the geomorphic features and landforms, as well as the floors of the valleys which are extensively mud-cracked. An excellent and complete geomorphic map of the area included.

148. Bekkar, M.G. INTRODUCTION OF TERRAIN-VEHICLE SYSTEMS. PART
1: THE TERRAIN, PART 2: THE VEHICLE Ann Arbor, Univ.
of Michigan Press, 1969 846 pp., incl. photos, diagrs.
\$27.50 DLC TL243.B39

A highly systematic and critical review of the whole field of off-road locomotion. For generalists, systems managers, and individual inventors who must concern themselves with interdisciplinary efforts. Replete with scores of excellent diagrams of photographs. Bibliography exceptionally thorough and current. Contents: Techniques and instrumentation of measuring terrain values. Evaluation of vertical stress-strain relationships. Evaluation of Horizontal stress-strain relationships. Compound load-deformation of soil under horizontal and vertical loads. Repetitive loading and sinkage. Geometry of terrain surface. Distribution and variation of physical and geometrical terrain values. Sampling and taxonomy of terrain values. The mission and the concept of a vehicle. Basic models of soil-vehicle relationships. Models of dynamic vehicle behavior. Models of vehicle performance. Selecting vehicle concepts for a given mission and environment. Evaluating a vehicle concept or component idea. Implementing terrain-vehicle systems evaluation. References. Subject index. Author index.

149. Wilson, Eldred D. GEOLOGY AND MINERAL DEPOSITS OF SOUTHERN
YUMA COUNTY, ARIZONA Ariz. bur. mines, geol. ser. no.7,
bull. 134 1933 234 pp. DLC QE86.Y8W5

This publication reports the first systematic geological investigation dealing with the mineral deposits over all of southern Yuma County. The general geologic features of all the mountain ranges were studied and mapped. The arrangement is by mountain ranges within which the situation and accessibility, topography, geology, structure and mineral deposits are described.

150. Alimen, Henrietta PEBBLE POLYGONS IN DESERT SOILS (Polygones de cailloux sur les sols desertiques) France centre national de la recherche scientifique, colloques internationaux, no.35 pp. 211-17 1953 (French and English summaries) DLC

In the area between Ougarta and the Hammadian Plain, red sandy clay (decomposition facies of primary schists) shows on its surface a network of polygons of great size (100-140 cm.). On the sides of these are found slightly flattened furrows in which pebbles have collected. They are not deeply imbedded but lie in the furrows. The surface of the polygon is flat or slightly convex and are found in areas protruding from the surrounding topographic surface. Apart from their exterior appearance, they have nothing in common with the usual polygon soil. There seems to be a correlation between their formation and the circumstances governing the condition of surface water in arid zones.

151. Olmstead, F.H. and C.C. McDonald HYDROLOGIC STUDIES OF THE LOWER COLORADO RIVER REGION Water resources bull., v.3, no.1 pp. 45-58, incl. illus., 1967

The Geological Survey in 1960 began a comprehensive study of the hydrology of the lower reaches of the main Colorado River Valley from Davis Dam to the International Boundary, and of certain adjacent areas that receive water from the river. The study includes an appraisal of the probable water supply available to the area, consumptive uses by crops, native vegetation, and evaporation, with greatest emphasis on the location and movement of ground water which may be available for development. Although the final results of the study were not yet available, the objectives, scope, methods used, and some preliminary results are described.

152. Green, Christine R. and Paul C. Kangieser PROBABILITY OF LOW TEMPERATURES OCCURRING IN ARIZONA Arizona University Inst. Atmos. Phys., Arizona Climate: Supplement No.2, April 1967 23 pp., incl. tables, map, ref.

Publication provides information on the terminal occurrence (first in the fall, last in the spring) of low temperatures. The locations of the 83 stations are shown and their latitudes, longitudes, elevations and descriptions tabulated. Results of the analysis presented include, (1) the dates in the spring on which the probabilities of the last occur-

rences of 40, 36, 32, 28, 24, 20, and 16 degrees F decrease from 90%, 75%, 50%, 25% to 10%. (2) The dates in the fall on which the probabilities of the first occurrences of the same temperatures increase from 10% to 90%, through the same intermediate values, and (3) the mean length of the growing season, i.e., the number of days between the last occurrence of a given threshold in the spring and its first occurrence in the fall at the 50% probability level. When thresholds did not occur every year, the probabilities were estimated by the combination method. (Thom, 1959).

153. Harris, David R. RECENT PLANT INVASIONS IN THE ARID AND SEMI-ARID SOUTHWEST OF THE UNITED STATES Assoc. Amer. Geographers, ann., v.56, no.3 pp. 408-22, incl. maps, illus. September 1966 DLC 63.A7

Several southwest plant communities between the plateaus and plains which formerly supported grassland have now been invaded by mesquite and other native shrubs, and the stream courses, which have been extensively occupied by tamarisk. With the settlement of the SW and commercial livestock ranching came increased seed dispersed, overgrazing, and suppression of grass fires, the combined effect of which favored the woody plants invasion. Climatic fluctuations toward greater aridity have tended to accentuate the processes. These invasions illustrate how man may unintentionally bring about rapid and profound ecological changes in dry areas by the introduction of new systems in land use.

154. Green, Christine R. HEATING AND COOLING DEGREE-DAY CHARACTERISTICS IN ARIZONA Ariz. Univ. Inst. Atmos. Phys., Tech. repts. on meteorol. & climatol. of arid regions, No.10 64 pp., incl. graphs, tables, map February 1962 DLC QC993.7.T4

A twofold study of degree-day data made for 49 Arizona weather stations. The first section analyzes the possibility of temperature trends occurring in Arizona. The second section discusses heating and cooling degree-day practical application with emphasis on the Tucson area. Weather stations located within the Sonoran Desert include: Yuma, Parker, Aguila, Wickenburg, Buckeye, Tempe, Sacaton, Gila Bend, Ajo and Florence.

155. Green, Christine R. SUMMER RAINY DAYS IN ARIZONA Ariz. Univ. Inst. Atmos. Phys., Tech. repts. meteorol. & climatol. of arid regions, No.11 61 pp., incl. graphs, tables January 15, 1963 DLC QC993.7.T4

June through September rainy days for 22 Arizona weather stations with 50 or more years of record are tabulated, graphically presented, and discussed. Data was included from the following desert weather stations: Yuma, Date-land, Mesa Experimental Farm, and Wickenburg.

156. Green, Christint R. DISTRUBUTION OF RAINFALL IN ARIZONA Ariz. Univ. Inst. Atmos. Phys., Tech. repts. on meteorol. & climatol. of arid regions, No.13 18 pp., incl. tables, 4 ref. 1963 DLC, QC993.7T4

Analysis of Arizona rainfall distribution has been divided into two sections in this report. The first part studies the various size rains and their frequency distribution at 46 weather stations for the 11 year period 1948-1958. The second analysis considers daily rains at 32 weather stations with long records and calculates the contribution made by the 5 and 10 wettest days during each year toward that year's total precipitation.

157. Shreve, Forrest ACROSS THE SONORAN DESERT Torrey Botan. Club, bull., v.51 pp. 283-93, 1924 DLC QK1.T6

Following a brief description of the physiographic setting, Shreve describes the flora of the Sonoran Desert in detail. He states the relative luxuriance of the Sonoran Desert may be attributed to the occurrence of seasonal rainfall. The ecology of different flora is discussed. Included are three photos. There are no maps.

158. Thomas, H.E. et al EFFECTS OF DROUGHT IN THE COLORADO RIVER BASIN US Geol. Survey, Prof. Paper 372-F pp. F1-F51, incl. Tables, graphs, ref. 1963 DLC QE75.P9

The prolonged drought of 1942-1956 affected chiefly the lower part of the Colorado River Basin and did not extend into the upper basin (the chief water-producing area) until 1953. Areas served by the Colorado River had adequate water supplies in spite of the local deficiency of precipitation. In the Gila River Basin, there was a deficiency of streamflow during the drought year, and the water requirements of the present population exceed the yield of the basin even during years of average precipitation; the dificiency is overcome by mining of ground water.

159. Painka, Eric R. DESERT LIZARDS AND SPATIAL HETEROGENEITY
Ecology, v.47, no.6 pp. 1055-59 Autumn 1966 DLC QH540.E3

The number of lizard species in the flatland desert habitat is correlated with several different structural attributes of the vegetation. It is shown that both the horizontal and vertical components of spatial heterogeneity are correlated with the number of lizard species. The habits of the twelve component species are considered briefly as they relate to the partitioning of the biotope space. Three species are food specialists, eight display various substrate specificities, and only one species appears to be truly "convex." Two tests of the present interpretation of these results are proposed, and some speculations concerning Australian flatland desert lizards are made.

160. Turner, Raymond M., Stanley M. Alcorn and George Olin
MORTALITY OF TRANSPLANTED SAGUARO SEEDLINGS Ecology,
v.50, no.5 pp. 835-44, incl. illus., tables, graphs,
ref. 1969 DLC QH540.E3

Only 26 of an original 800 5-cm-tall saquaros (Carnegiea gigantea) survived for 3 months when accessible to the rodents and rabbits at Saguaro National Mounment, Arizona; after 1 year all of these small plants were gone. Although losses among a group of larger (15-cm-tall) seedlings were less abrupt, only one plant of an original 120 remained by the end of a year. When protected from these herbivores by cages, 12% of the smaller plants remained at the end of 1 year but only 2% after 5 years. Although browsing by rodents and lagomorphs quickly destroyed most uncaged small plants, the planting design probably accentuated the losses from the herbivores; in any event, many of these seedlings would soon have died from other causes.

161. Burt, W.H. FAUNAL RELATIONSHIPS AND GEOGRAPHIC DISTRUBUTION
OF MAMMALS IN SONORA, MEXICO Michigan University, Misc.
publ. Mus. Zool., no.39 77 pp., 26 maps 1938
DLC QL638.C95H9 no.39

A brief history of mammal studies in Sonora is given, followed by a discussion of some of the factors that influence the distribution of mammals in the state. Four biotic provinces are recognized for Sonora: Sonoran, Apachian, Sinaloan, and Durangan, The Durangan biotic province is proposed for the first time. The annotated list of mammals is based on previous literature and on collections in the Museum of Zoology of the University of Michigan and the Donald R. Dickey Collection at the California Inst. of Technology. 141 spp. and subspp. are recorded for the state, 31 of which had not been recorded previously.

162. Hely, Alan G. and Eugene L. Peck PRECIPITATION, RUNOFF,
AND WATER LOSS IN THE LOWER COLORADO RIVER - SALTON SEA
AREA US Geol. Survey, Prof. Paper 486-B 16 pp., incl.
illus., graphs, map DLC QE75.P9

In most of the area, including virtually all of the irrigable lands, the mean precipitation is less than 8 inches. Precipitation is strongly influenced by season and topography. Summer precipitation is almost insignificant in comparison with winter precipitation in the western part of the area, but in the southeastern part, summer and winter precipitation means are almost the same. Isohyetal maps of both seasonal and annual means are adjusted for the effects of topography. A map showing mean annual temperature is included because of the dominant effect of temperature on natural water loss and on use of water by man. The mean generally decreases about 32 degrees F for each 1,000 feet of increase in altitude, but does not change significantly with change in latitude. A large part of runoff generated by precipitation within the area is absorbed in the alluvium of the valleys and plains. Available streamflow records provide very little information regarding the local runoff, which, consequently, was estimated on the basis of precipitation data, rainfall-runoff relations, and observed characteristics of the terrain. Natural water loss includes evaporation from water surfaces and evapotranspiration from land areas and is relatively high in this area. Evaporation from reservoirs on the lower Colorado River, including Lake Mead, is estimated as about 1.2 million acre-feet -- nearly 10% of the mean annual streamflow in the lower Colorado River for 1931-1960.

163. Lustig, Lawrence K TREND-SURFACE ANALYSIS OF THE BASIN AND
RANGE PROVINCE, AND SOME GEOMORPHIC IMPLICATIONS US Geol.
Survey, Prof. Paper 500-D, 1969 70 pp., incl. illus.,
table, 58 ref. DLC QE75.P9

A quantitative analysis of variation in the spatial distribution of topographic parameters in the Basin and Range Province. Data were derived from 1:250,00 topographic maps. Of the methods of analysis considered, trend-surface analysis is preferred and employed. Conclusions include: (1) the recognition of three distinctive areas within the province (SW Arizona/SE California; NW Nevada and parts of E California; and the eastern part of the province); (2) variance of the topographic data indicates that the topography reflects different erosional histories and relief ages of the ranges; (3) by and large, alluvial fans are more abundant in areas with relatively large

average values of range width, length, height, relief, volume and area of ranges of total area, and pediments occur mainly where these values are relatively small; (4) regional drainage distinctions compatible with the other conclusions must exist. The hypothesis is offered that mass reduction of a mountain mass, and pediment development results from weathering processes on steep mountain fronts in interfluvial areas and fluvial processes in drainage basins.

164. Cameron, Roy E. COMMUNITIES OF SOIL ALGAE OCCURRING IN THE SONORAN DESERT IN ARIZONA Ariz. acad. sci., jour., v.1 pp. 85-88 1960 DLC unbound

(not seen, not in LC)

165. Turnage, William V. and T.D. Mallery AN ANALYSIS OF RAINFALL IN THE SONORAN DESERT AND ADJACENT TERRITORY Washington, Carnegie Institution, Pub. no.529, 1941 45 pp. DLC QC925.I.U65

A complete summary of a series of weather stations located in the deserts of southern California, Arizona and eight stations in Sonora, Mexico. Figures for summer and winter rainfall, some run-off data, and brief descriptions of the general topography are presented. Rainfall data started in 1917-1918 and was continued up to 1936-1937. Complete list of figures for each station are tabulated at the end of the article.

166. Wilson, Eldred D., Richard T. Moore and John R. Cooper GEOLOGIC MAP OF ARIZONA Tucson, Ariz. Bur. Mines, 1969 scale 1:500,000

167. Cameron, Ray E., G.B. Blank, and D.R. Gensel SAMPLING AND HANDLING OF DESERT SOILS Jet Propulsion Lab, Calif. Inst. Tech., Pasadena, Calif., NASA-CR-74590, JPL-TR-32-908, April 15, 1966 45 pp., incl. ref. N66-23860: CFSTI, HC \$2.00;MF \$0.50

Variability and characteristics of terrestrial soils and variability in methods and techniques used in sampling and handling are important factors responsible for discrepancies in results of investigations on soils. Procedures for soil sampling as well as selection of the soil to be sampled, are usually determined by the purpose for which the soil will be used. Information is presented for the sequential selection, characterization, and sampling of a desert soil site. Procedures are recommended and illustrations given for photography

of major features, sterilization of sampling equipment and sample containers, the collection of desert soils, and their handling, processing, storage, shipment, and dispersal. Aseptic technique is emphasized for the collection and handling of soil samples for microbiological studies.

168. Dice, Lee R. and Phillip M. Blossom STUDIES OF MAMMALIAN ECOLOGY IN SOUTHWESTERN NORTH AMERICA WITH SPECIAL ATTENTION TO THE COLORS OF DESERT MAMMALS Carnegie Institution of Washington, Pub. 485, 1937 129 pp., incl. illus., tables, graphs, map, ref. DLC A532.A5

Regions covered in this study include SE Arizona, SW Arizona and a small part of Sonora, Mexico. Many local races of mammals, distinguished for the most part by differences in pelage color, occur in the arid regions of southwestern North America. Evidence seems conclusive that in the SW the pelage color of the mammals tends to be correlated with the color of the soils of their habitats. Also discusses the processes of isolation, mutation, and selection which are assumed to be operative in the production of local races.

169. Beheiry, Salah A. SAND FORMS IN THE COACHELLA VALLEY, SOUTHERN CALIFORNIA Assoc. amer. geographers annals, v.57, no.1 pp. 25-48, incl. illus., tables 1967 DLC G3.A7

Coachella Valley in southern California is in places mantled by sand deposits. From the source of the sand, alluvial deposits in the north end of the valley, prevailing winds sift out finer materials and move them southward, creating several kinds of sand forms during transport. Knob dunes, which may occur in large dune fields, wave dunes, which are barchan-like in form, mesquite-hill dunes, which collect around patches of mesquite, and other sand forms such as sand drifts, undulations, and sand veneers are present. Although present conditions of sand transport are affected by cultural interference, there is a sequential aspect to the development of sand forms, in which the sand veneer thickens into a field of knob dunes, may become a moving field of undulating form, ending in the barchan-like form in terminal downwind locations.

170. Beaty, Chester B. ORIGINS OF ALLUVIAL FANS, WHITE MOUNTAINS, CALIFORNIA AND NEVADA Assoc. amer. geographers, ann., v.53, no.4 December 1963 pp. 516-35, 21 ref. DLC G3.A7

Alluvial fans of the White Mountains, and by analogy, those of other Great Basin ranges, appear not to have been built by the ordinary processes of stream deposition. Instead, spectacular episodes of debris-flow deposition have been irregularly interspersed with periods of quiescence, during which unconsolidated material has accumulated on canyon floors. From time to time cloudbursts have occurred, and enormous volumes of debris have been shifted from the mountains to the subjacent fans. During intervals between major rubble flows, while mass movements and other slope processes have been transferring debris from canyon walls to trunk canyon floors within the mountains, morphologic changes on the fans have been minor. In the Great Basin environment the spectacular seems to have been the normal, for it is by spectacular processes that a large share of the grand work of gradation has been carried out.

171. Ambe, Yoshinari SECULAR VARIATION OF ARIDITY IN THE WORLD Japan, jour. geol. geogr., v.38, no.1 pp. 43-61, incl. illus., 21 ref. 1967 DLC QE1.J35

Through the study of secular variations of the position and the patterns of the major arid regions in the world, the regional characters of recent climatic variation are discussed. No remarkable changes with any particular trend are found in the period 1931-1960, rather periodic fluctuations are dominant. Comparing variations of the arid region in each continent, some parallelism in the variation of arid climate on a hemisphere scale or on a continental scale are found, but no conspicuous changes of a global scale are found.

172. Ambe, Yoshinari REGIONALITIES OF CLIMATIC VARIATIONS OF THE
WORLD Japan. jour. geol. geogr., v.38, no.1 1967 pp. 63-77,
9 ref. DLC QE1.J35

Yoshinari's previous article (see abstract) discussed variations in arid climate continent by continent. Here he discusses the variations within each continent. The boundaries of arid areas for the period 1931-1960 are plotted continent by continent and the extent of variation is noted. Maps of the variability of climate are then constructed for each continent. From these a world map is produced in which regions which are always arid are distinguished from transitional type of climate with occasional aridity.

173. American Society of Civil Engineers SEDIMENT TRANSPORTATION
MECHANICS -- WIND EROSION AND TRANSPORTATION -- CLOSURE (To
Discussion of Paper 4261, 1965) Its Proceedings, v.92, Jour.
hydraulics div., n. HY 5 1966 pp. 195-97 DLC TC1.A39

In condensing material on wind erosion for the manual, considerable detail was omitted including discussion of the effects of moisture content of soil on wind erosion, believed by Raudkivi and Chepil to be important. Corrections are given here to equations expressing the rate of movement of moistened erodible particles on "smooth" soil surfaces. In bare soils containing a mixture of erodible and nonerodible fractions, the quantity of soil removed by wind is limited by the height and number of nonerodible fractions that become exposed on the surface. Because formation of dunes and ripples is not a prominent problem on arable lands, the committee did not treat this in detail.

174. Anderson, A.J. and E.J. Underwood TRACE-ELEMENT DESERTS
Scient. amer., v.200, no.1 Januray 1959 pp. 97-106, incl.
illus., map DLC T1.S35

Trace elements now recognized as essential to plant life are Fe, Mn, Cu, Zn, Mb, B, and Cl. Cu, Zn, and Mb are the elements that cropland and pasture lack most often. Until recently, South Australia's Ninety Mile Desert was wasteland. Infertility of the soil was found to arise from the lack of trace quantities of Zn and Cu which was then remedied. This type of soil reclamation is being initiated in other parts of Australia where deficiencies of essential trace elements are being reduced. While Cu and Zn deficiencies occur in southern and western Australila, the east suffers mainly from lack of Mb. Trace-element dificiencies affect animal productivity. Although trace-element dificiencies have little direct effect on man, their indirect effects are profoundly important.

175. Artsybashev, E.S. STUDY OF THE SPECTRAL BRIGHTNESS OF SOME LANDSCAPE ELEMENTS FOR INTERPRETATION OF GROUND WATER ON AERIAL PHOTOGRAPHS Trans. of Aerometodov dlya izuchenia gruntouyhk vod, 1962 pp. 90-123 Washington DC, US Army Foreign Science & Tech. Center, Rept. no. FSTC-HT-23-353-68, June 26, 1969 42 pp. AD 692 647

The report presents experience in the study of the spectral reflectivity of some landscape elements (primarily vegetation and soils) which are ground water indicators and describes the use of these data for the hydrogeological interpretation of aerial photographs. The studies were made during 1958-1960 in two geographical zones of the Soviet Union: desert (Turkmenia) and semi-desert (Caspian Lowland). The method for interpreting ground water described in this paper was checked by making similar studies in the forest zone of the northwestern regions of the USSR. The objects for spectral photometric studies in each geographical zone were those types of vegetation and soils which form the basic appearance of the landscape.

176. Avnimelech, Moshe A. A BIBLIOGRAPHY OF LEVANT GEOLOGY, INCLUDING CYPRUS, HATAY, ISRAEL, JORDANIA, LEBANON, SINAI AND SYRIA Jerusalem, Israel Program for scientific translations, 1965 208 pp. Available from: Danial Davey and Co., Inc. N.Y. \$6.00 DLC Z6034.L4A9

Approximately 4500 entries arranged by alphabetical order of authors, chronological index, and analytical subject index. The latter lists all publications under headings of geographical and stratigraphical units, paleontological categories, various problems of applied geology, especially those of oil and water geology, and mineral resources. A note indicates that it is intended "to continue the publication in yearly or two-yearly issues in a similar arrangement of entries, but with the addition of short annotations."

177. Axelrod, Daniel I. THE PLEISTOCENE SOBOBA FLORA OF SOUTHERN CALIFORNIA Calif., Univ., Pubs. geol. soc., 60, 109 pp., incl. illus., tables, 81 ref. 1966 DLC QE1.C15

The Soboba flora, from a locality near San Jacinto in interior southern California, is preserved in lake beds in the lower part of the Pleistocene Bautista Formation. It is composed of 41 species assigned to five plant communities. Ceratophyllum and Typha contributed to an aquatic association. A stream-and-lake-border woodland included Acer, Cornus, Fraxinus, Platanus, Populus, Quercus, Rhus, and Salix. Two different forests occupied the immediate area: a Bigcone spruce-Coulter pine forest covered nearby slopes and yellow pine forest reached down to the lake margin in cool valleys. Exposed slopes supported a chaparral. Woody plant communities similar to those in the flora regularly interfinger in the nearby mountains today, but at altitudes 2500-3000 feet above the Soboba basin.

178. Badoux, Heli REMARKS ON THE MORPHOLOGY OF THE COLORADO PLATEAU Soc. Vaudoise Sci. Nat. Bull. 326, v.70, no.1 pp. 1-10 incl. illus., 1968 Reprinted as: Lausanne Univ. Lab. geologie, mineralogie, geophysique et mus. geol. bull. 170 1968 DLC Q67.L3

The history of exploration, stratigraphy, tectonics, and geomorphologic evolution of the Colorado Plateau, including the Grand Canyon, are reviewed briefly. Successive stages of uplift and erosion, culminating in a denudation platform, are shown in a series of diagrammatic cross sections.

179. Bassett, Allen M. and Donald H. Kupfer A GEOLOGIC RECONNAISSANCE
IN THE SOUTHEASTERN MOJAVE DESERT, CALIFORNIA Calif. Div.
Mines & Geol., spec. rept. 83 43 pp., incl. illus., map,
tables, 49 ref. 1964 DLC TN42.C2A33 no. 83

The area mapped in this geologic reconnaissance, about 3500 sq. miles of the southeastern Mojave Desert in San Bernardino County, California, contains predominantly Cenozoic volcanic and sedimentary rocks in the northwestern half and principally pre-Cenozoic plutonic and metamorphic rocks in the southeastern half. Reconnaissance was concerned primarily with distribution and lithology of Cenozoic rocks; the older rocks and the economic resources of the area were studied in less detail.

180. Battan, Louis J. and Richard A. Kassander, Jr. SUMMARY OF RESULTS
OF A RANDOMIZED CLOUD SEEDING PROJECT IN ARIZONA In:
Berkeley, symposium in mathematical statistics and probability,
5th Berkeley, June 21-July 18, 1965 and December 27, 1965 to
January 7, 1966, Proceedings, v.5: weather modification
Berkeley, Univ. of California Press, 1967 pp. 29-33, illus.,
tables, ref. DLC QA276.B4

Presents a summary of results of a randomized cloud seeding project carried out during 1947-1960 over the Santa Catalina Mts. in southeastern Arizona. Data summaries presented represent mean rainfall per station on seeded and not seeded days. AgI seeding was carried out by means of an airborne generator. Statistical tests indicate that the observed results could easily have occurred by chance, and thus the hypothesis that seeding had no effect cannot be reasonably rejected. The data do not support the idea that AgI seeding can increase precipitation at the ground. And observed differences suggest that if there were any effect at all, it was to cause a reduction of rainfall. It is added that these results cannot be extrapolated to other techniques, other regions, or even other clouds of similar appearance elsewhere.

181. Addor, E.E., V.E. LaGarde, J.K. Stoll and H.K. Woods
A USER-ACCESSED COMPUTER INFORMATION SYSTEM FOR ENVIRONMENTALLY
SENSITIVE WILDLIFE, 3 vol. Technical Report M74-6 US Army
Engineer. Waterways Experiment Station, Vicksburg, Miss. June
1974

Describes a user-accessed computerized information system for rare, endangered and legally protected animal species and subspecies. Taxa information is arranged by state, and includes degree of protection under Federal and state law, geographic distribution, behavioral characteristics and habitat requirements, population structure and trends, and a list of information sources.

182. Alcorn, Stanley M., S.E. McGregor and George Olin
POLLINATION OF SAGUARO CACTUS BY DOVES, NECTAR-FEEDING BATS,
AND HONEY BEES Science, v.133, no.3464 1961 pp. 1594-95
DLC Q1.S35

In a large cage, free-flying western white-winged doves, nectar-feeding *Leptonycteris* bats, and honey bees were each effective as cross-pollinators of self-sterile saquaro flowers. Seed production and seed viability were not significantly different in fruit from flowers pollinated by these agents. Pollination is not a limiting factor in saquaro repopulation.

183. Alexander, Charles S. LANDFORMS OF THE COLORADO DELTA
In: Leestma, R.A., and R.A. White (eds.), Earth resource
survey from spacecraft Vol. 2 Houston, NASA Earth Resources
Group pp. E34-E37, incl. illus. 1969

Shore forms are identified on overlays to three Gemini photos, and the classification in terms of which they are identified is given. Features shown include volcanoes, alluvial fans, sand dunes and salt marshes.

184. Meyer, Milton W. and Lyle T. Alexander STRONTIUM 90 SOURCES
IN SOILS OF ARID REGIONS: RAINFALL, DRY FALLOUT, AND IRRIGATION
WATER Soil sci., v.99 1965 pp. 234-35, 3 ref. DLC
S590.S6

Data for Mohave County and Yuma: small, but not important amounts of strontium are added to soils through irrigation water.

185. American Institute of Crop Ecology THE PHYSICAL ENVIRONMENT
AND AGRICULTURE OF THE DESERT REGION OF CALIFORNIA AND ARIZONA
CONTAINING AREAS CLIMATICALLY AND LONGITUDINALLY ANALOGOUS TO
THE NEGEV OF ISRAEL, A STUDY BASED ON OFFICIAL RECORDS By
M.Y. Nuttonson Washington, 1962 309 pp. DLC S448.A7

Although written to facilitate greater farm crop potential of the Negev of Israel, this report is useful to the project because it surveys in considerable detail the physical environment of the desert regions of California and Arizona, including the climate and soils of Imperial Valley, Coachella Valley, Palo Verde Valley, Yuma County, and Salt River Valley.

186. Anstey, R.L. A COMPARISON OF ALLUVIAL FANS IN WEST PAKISTAN AND THE UNITED STATES Pakistan geograph. rev., v.21, no.2 pp. 14-20, incl. illus., 1966 DLC DS376.P29

Two important environmental factors in the development of alluvial fans are amount and intensity of rainfall and type of terrain. The folded-faulted terrain in the Basin and Range region of the United States is similar to that of the Baluchistan group of mountains in West Pakistan and rainfall is similar in both areas. The research methods involved (1) measuring, quantifying and showing the frequency of occurrence of the physical characteristics of fans, (2) determining their spatial distribution and (3) comparing the facts obtained in similar environments in Pakistan and the United States. Fans were detected on small scale (1:62,500) topographic maps. Two, one degree quadrangles were investigated in each region. Alluvial fans shown on topographical maps were classified by size. For intercountry comparisons random samples of a hundred fans in each area were evaluated. Close agreement was found between the total gradients of fans in both regions.

187. Anstey, Robert L. PHYSICAL CHARACTERISTICS OF ALLUVIAL FANS US Army Natick Labs., Mass., Tech. rept. TR-ES-20, Dec. 1965 97 pp. AD 627 707; CFSTI HC \$3.00, MF \$0.75

An areal quantification of the geometry of alluvial fans was completed for a total of seven 1-degree quadrangles (1 degree Latitude x 1 degree Longitude) of representative desert terrain in the United States and West Pakistan. The greatest development of alluvial fans is associated with mountainous desert regions having wide valleys. Alluvial fans are not related to high mountainous areas or to areas where the mountain mass has been deeply dissected by steep, narrow valleys. Within desert regions it was noted that landform data in one physiographic province were very similar to those in the same type of province (such as a folded-faulted type) and climate elsewhere. Except for similar provinces the agreement was not close.

188. Appleby, J. Fred and W.D. Ohmstede VERTICAL TEMPERATURE GRADIENTS IN THE FIRST 200 FEET OF THE ATMOSPHERE OF THE ARIZONA DESERT US Army Electronics Res. & Develop. Activity, Ft. Huachuca, Ariz., Meteorol. Res. Notes no.4, January 1963 110 pp., 17 refs. DWB

Reports the results of a program of observation and analysis of the vertical distribution of temperature in the air layer near the ground, and discusses the significance of the mechanism of turbulent transfer. Data were collected during the winter and summer of 1956, in southwestern Arizona. Results are given in terms of the spatial and temporal distribution of temperature. Emphasis is placed on the daytime inversions, between 100 and 200 feet in summer, which are associated with light windspeed. A hypothetical model of buoyant element is presented that qualitatively accounts for the phenomenon of heat flux against the potential temperature gradient.

189. Arizona, State Bureau of Mines FOLIO OF GEOLOGIC AND MINERAL MAPS OF ARIZONA Tucson, Ariz., University of Arizona Press, 1962 DLC G1511.C5A7 1962 MAP

(LC Card note: LC copy imperfect; Ariz. Bur. Mines Bulls. 170 & 171 missing).

190. Arkley, R.J. CLIMATES OF SOME GREAT SOIL GROUPS OF THE WESTERN UNITED STATES Soil Sci., v.103 pp. 389-400, 1967 DLC S590.S6

An important publication in which climates of 15 great soil groups were analyzed using parameters of climate for 1082 weather stations taken from the water balance calculated according to Thornwaite. The dominant great soil group at each station was identified on a general soil map and results indicate that each great soil group falls within distinct limits of these climatic parameters, although there is some overlapping between great soil groups.

191. Barnett, Frank, Judy Ehlen, Jerry Gilbert and Janet Sunderson
SURFACE MATERIALS AND TERRAIN FEATURES, TRIGO PEAKS Overprint
on USGS 1:62,500 series composite, US Army Engineer Topographic
Laboratories, Ft. Belvoir, Va., July 1973

Surface materials and bedrock types of Trigo Peaks Quadrangle and
USAYPG portions of Cibola and Dome Rock Mts. prepared for
the inventory of surface materials on YPG.

192. Barnett, Frank, et al SURFACE MATERIALS AND TERRAIN FEATURES,
ENGESSER PASS Overprint on USGS 1:62,500 series composite,
US Army Engineer Topographic Laboratory, Ft. Belvoir, Va.
May 1973

Surface materials and bedrock types of USAYPG portions
of Engesser Pass, Palomas Mts., and Little Horn Mts. quad-
rangles, prepared for the inventory of surface materials
on YPG.

193. Beheiry, Salah A. SAND FORMS IN THE COACHELLA VALLEY, SOUTHERN CALIFORNIA Annals of the Assoc. of Am. Geographers v.57, no.1 (March 1967) pp. 25-48, 20 illus., 11 ref.

The Coachella Valley is a northern section of the Salton Basin partially covered by alluvial deposits and, in a few localities, is mantled by sand deposits. Forms include knob dunes (applicable to YPG area), elongated low mounds formed in the lee of desert shrubs, ranging up to six feet high and thirty-five feet long; wave dunes, barchan-like in form; mesquite-hill dunes; sand drifts sand undulations; and sand veneers (the latter three also applicable to YPG).

194. Benson, Lyman CACTI OF ARIZONA 3rd ed., Univ. of Arizona Press, Tucson, Arizona, 1969 218 pp., 18 tables, 126 illu., 41 maps LC No. 70-77802; SBN 8165-0191-2

A clearly detailed classification of the sixty-eight species and their varieties of Arizona cacti. Well organized, the volume unfolds through keys for identification and classification; through information on distinguishing characteristics, geographical distribution, and synonymy. The text is supported by drawings, photographs, and distribution maps.

195. Benson L. and R.A. Darrow TREES AND SHRUBS OF THE SOUTHWESTERN DESERTS 2nd ed. Tucson, Univ. of Arizona Press, 1954 437 pp., incl. illus., maps DLC QK481.B4 1954

A slightly revised second edition of Benson's 1944 work, A Manual of Southwestern Desert Trees and Shrubs. The introduction considers the vegetation of the southwestern deserts, mapping and characterizing the Mojave, the Sonoran (in its two subdivisions, the Colorado and the Arizona), and the Chihuahuan Deserts, and then gives brief outlines of adjacent vegetational types. Information is then given on the morphology of flowers, fruits and leaves, as will facilitate the use of the technical keys. The body of the work provides descriptions of the flora, giving keys to families, genera, and species, and, for the last, both illustrations by drawing or photographs and maps showing the geographic distribution. An appendix records "Scientific synonyms and type collections," and provides extensive bibliographic information.

196. Bentley, P.J. ADAPTATIONS OF AMPHIBIA TO ARID ENVIRONMENTS
Science 152 (3722), 1966 pp. 619-23

Amphibia utilize the skin to collect water from damp surfaces and to assist rapid rehydration. Extra water can be stored in and subsequently reabsorbed from a large urinary bladder. Mechanisms and processes are discussed.

197. Cloud, William K. and Nina H. Scott THE BORREGO MOUNTAIN, CALIFORNIA, EARTHQUAKE OF 9 APRIL 1968: A PRELIMINARY ENGINEERING SEISMOLOGY REPORT Seismol. soc. Amer., bull., v.58 no.3 pp. 1187-1191, incl. table, graph, ref. March 1969
DLC QE531.S3

The magnitude 6.5 Borrego Mt. earthquake at 0:29, approximately, on April 9, 1968 (GCT), activated strong-motion seismographs throughout southern California and in the Las Vegas, Nevada area. A total of 112 records were obtained of which, approximately 55 appear to have scaleable trace amplitudes. A preliminary review of reports from an extensive canvas by the Coast & Geodetic Survey indicates that the generally felt area of the earthquake was approximately 60,000 sq. miles.

198. Cabaniss, Gerry H. GEOPHYSICAL STUDIES OF PLAYA BASINS
In: US Air Force, Cambridge Res. Labs., Geology, mineralogy and hydrology of the US playas Ots Environmental res. paper 96 (AFCRL-65-266), pp. 123-147, incl. illus., tables, 1965
DLC TRC: AD 616 243

Geophysical studies made by several universities and government agencies of some of the interior basins of California and Nevada have revealed that many are partially filled with thick 5,000 to 10,000 feet sequences of Cenozoic sediments and volcanics. Consideration of various geophysical methods (seismic, gravimetric, magnetic, and electrical) and the results from preliminary surveys lead to the conclusion that the seismic techniques are most adaptable to the study of playas, but that electrical methods require additional testing to determine their efficacy in this particular geological environment. Gravity profiles across four playas permit some qualitative interpretation of the structure of the underlying bedrock but show only minor anomalies associated with density variations in the playa sediments.

199. Canada Geological Survey THE WORLD RIFT SYSTEM. INTERNATIONAL UPPER MANTLE PROJECT. REPORT OF SYMPOSIUM, OTTAWA, CANADA, 1965 Canada Geol. Survey Paper 66-14, 1966 471 pp. DLC

Articles of potential value to the project include: M.L. Hill, The San Andreas System, California and Mexico, pp. 239-45; K.L. Cook, Rift System in the Basin and Range Province, pp. 246-79; G.A. Thompson, The Rift System of the Western United States, pp. 280-290; and W. Hammilton, Cenozoic Tectonic of the Western United States, pp. 291-306.

200. Capot-Rey, Robert THE FRENCH SAHARA (Le Sharar Francaise) Text in French Paris Presses Universitaires de France, 1953 564 pp., incl. illus., tables, 818 ref. (France. Pays d'outre-Mer. 4e ser: Geographie de l'union Francaise no. 1, L'Afrique Blanche Francaise, vol. 2) DLC DT33.D38

A thorough treatise on the French Sahara. Topics discussed include the desert limits, hydrology, soil, climate, climatic changes, geological structure and geomorphic landforms, all regional.

201. Chrishan, Clifford S. and Rayden A. Perry ARID-LAND STUDIES IN AUSTRALIA In: Arid Lands In Perspective, ed. by Wm. G. McGinnies and B.J. Goldman Washington, Am. Assoc. for the advancement of science, 1969 pp. 209-25, incl. illus., map, 59 ref. DLC 5613.A7

With about 75% of Australia classified as arid, a substantial increase of interest in arid-zone studies has begun. New projects are under way and new facilities constructed to aid the research. Information is included in regard to existing knowledge of the land resources, climate, water resources, vegetation, native and domestic animals, insects and economies.

202. Bull, William B. RELATIONS OF ALLUVIAL FAN SIZE AND SLOPE TO DRAINAGE-BASIN SIZE AND LITHOLOGY IN WESTERN FRESNO COUNTY, CALIFORNIA US Geol. Survey, Prof. paper 450-B pp. 51-53, 2 ref. 1962 DLC QE75.P9

Large alluvial fans along the western border of the San Joaquin Valley have gentler slopes and larger source areas than do small fans. Fans derived from mudstone -- or shale-rich drainage basins are: (1) steeper than fans of similar area that are derived from sandstone-rich basins, and (2) larger than fans of similar slope from sandstone rich basins. (These relations demonstrate not only some fundamental concepts of fan morphology but also the effect of drainage-basin lithology on the areal extent and thickness of deposits susceptible to near-surface subsidence when wetted. Near-surface subsidence seriously hinders engineering and agricultural operations on certain alluvial fans.)

203. Bull, William B. ALLUVIAL-FAN DEPOSITS IN WESTERN FRESNO COUNTY, CALIFORNIA Jour. geol., v.71, no.2 pp. 243-51, incl. illus., graphs, table, map, 12 ref. March 1963 DLC QE1.J8

Deposition on alluvial fans is caused mainly by decrease in depth and velocity of flow, which results from increase in width as flow spreads out in a fan. The alluvial-fan deposits of western Fresno County, are mud-flows, water-laid sediments, and intermediate types. Common voids in the deposits are intergranular openings between grains that are held in place by a clay bond, bubble cavities, interlaminar openings in thinly laminated sediments, and buried, but unfilled, polygonal cracks.

204. Brune, James N. and Clarence R. Allen A LOW-STRESS DROP, LOW-MAGNITUDE EARTHQUAKE WITH SURFACE FAULTING -- THE IMPERIAL, CALIFORNIA, EARTHQUAKE OF MARCH 4, 1966 Seismol. soc. Amer. bull., v.57, no.3 pp. 501-14, incl. illus., table March 1967 DLC QE531.S3

Up to 1.5 cm of right-lateral surface displacement occurred over a 10 km section of the Imperial fault as a result of an earthquake of $M=3.6$, the smallest known earthquake yet associated with surface displacement. The association of the displacement with this earthquake is supported by the shallow focal depth, high excitation of Love waves of 8- to 15- sec period, the distribution of aftershocks, and the agreement of source movement calculated from observed faulting and from Love wave amplitudes. A fault depth of 1.1 km, net moment of 2×10^{22} dyne-cm, stress drop of 1.1 bar, and energy release of 10^{17} ergs are calculated.

205. Brown, Glen F. GEOMORPHOLOGY OF WESTERN AND CENTRAL SAUDI ARABIA
Internatl. geol. cong., 21st, Norway, 1960, Proc., part 21 pp.
150-59, incl. illus., map, ref. 1960 DLC QE1.I6 1960

Saudi Arabia is part of a large low latitude desert which has been arid throughout much of the post-Cambrian. The peninsula has been split off from the African plateaus by the Red Sea and Gulf of Aden rifts -- part of a network of tectonic zones separating blocks whose epirogenic activities have interrupted and modified the desert cycles of erosion in a way that lends itself to an interpretation of the history. In western and central Arabia the physiographic provinces or belts are, from west to east, the Tihama or Red Sand coastal plain; the scarp mountains; the ramped plateau of Hijaz rising in the south at the eastern edge of the scarp mountains and its counterpart the Hisma plateau in the north; and the inselbergs and high desert plains of Najd underlain by crystalline rocks sloping gently east to the west-facing cuestas of Central Arabia.

206. Brooks, F.A. and C.F. Kelly INSTRUMENTATION FOR RECORDING MICRO-CLIMATOLOGICAL FACTORS Amer. geophys. union, trans., v.32, no. 6 pp. 833-846, Dec. 1951 DLC QE500.A6

A scheme for classifying weather types for continental US is outlined; it depends upon air mass and cloud cover. The meteorological variables involved in the heat exchange between plants and animals and their surroundings are given. The special instruments developed for measuring heat flow (globe thermometers) and capillary evaporation (Livingston atmometer), a portable microweather station for describing climate at level of plants and animals, and the recording potentiometer which makes possible hourly recording of all regular weather observations are described. An example of the estimation of the heat balance between sky and ground radiation at El Centro, California, is presented.

207. Butzen, Karl W. CLIMATIC CHANGES IN THE ARID ZONE OF AFRICA DURING EARLY TO MIDHOLOCENE TIMES In: International Symposium on World Climate, Imperial College, London, 1966: World Climate from 8000 to 0 B.C. London, Royal Meteorological Society, 1966 pp. 72-83 DLC QC884.I5S 1966

The arid zones of Africa, subject to comparatively dry climate during more recent geological times, have experienced a minimum of moisture or drier oscillations during the Pleistocene and Holocene. Various classes of paleoclimatic evidence are reviewed briefly. Despite advances of the last decade, the present status of information is still unsatisfactory, due in part to limited numbers of workers and the difficulties of exact dating and reliable conversation. Changes in precipitation or effective moisture cannot be quantitatively defined and a paleoclimatic outline is not yet possible.

208. Brandt, Herbert ARIZONA AND ITS BIRD LIFE: A NATURALISTS ADVENTURE WITH THE NESTING BIRDS ON THE DESERT, GRASSLANDS, FOOTHILLS AND MOUNTAINS OF SOUTHEASTERN ARIZONA Cleveland, Bird Res. Found., 1951, 723 pp. QL 684.A6B7

This comprehensive volume with its many excellent photographs and paints is divided into four major sections: deserts, grasslands, foothills, and mountains.

209. Buffington, Lee C. and Carlton E. Henlel VEGETATION CHANGES ON A SEMIDESERT GRASSLAND RANGE FROM 1858 to 1963 Ecol. monogr., V.35, no.2 pp.139-54, 55 ref. 1965
DLC QH540.E28

Vegetation surveys of 1854, 1915, 1928 and 1962 were compared for the Jornada Experimental Range, near Las Cruces, N.M., in order to show the degree of encroachment of brush on semi desert grassland and the nature of the invasion on unions of soil types. Mesquite, Creosote brush and Tarbrush with all combinations were mapped at three density levels. In 1858 grass was present over 90% of the area with 2/3 free of brush. By 1963 only 25% was good grass with practically all of that with brushes. All three brush types had greatly extended their range and density. Mesquite invaded sandy soil, Creosote on shallow, coarser textured soils on slopes where a good stand of grass was present at the start and Tarbrush increased in area both in lighter soils with other brush species and into heavier soils.

210. Brand, D.D. THE NATURAL LANDSCAPE OF NORTHWESTERN CHIHUAHUA, MEXICO New Mexico, Univ., bull., geol. ser., v.5, no.2 74 pp. incl. illus., map 1937 DLC QE1.N45

Based on two years of field work in northwestern Chihuahua in 1929-1931, the paper is almost purely descriptive and distributional in its treatment of the physical landscape, and little or no attempt is made to discuss geomorphic problems. The areal limits are outlined, the physiographic provinces of Mexico discussed (those of Thayer and Hill), and the surface configuration outlined. The mountains, major depression, drainage basins, areas of channel trenching, and soils of the Basin and Range province are described. The land forms and soils of the Sierra Madre Occidental are also discussed. Brief sections are devoted to the climate, animal life and vegetation. The hydrology of the area is described in some detail in an appendix. A physiographic map is included. A most useful work on the Chihuahua region.

211. Brand, Donald B. NOTES TO ACCOMPANY A VEGETATION MAP OF NORTHWEST MEXICO (CHIHUAHUA) New Mexico Univ. Bull., biol. ser., v.4, no.4, No. 280 1936 27 pp.

Excellent article on the vegetation of Chihuahua, including a detailed map of the vegetation types and their distribution, an extensive bibliography of articles written on the flora of Mexico and a history of the vegetational studies of the region. The region studied is broken down into vegetation areas which include the Chihuahuan Desert, Sierra Madre Occidental, Sonoran Desert and the Sinaloa Tropical. The subdivisions of the Chihuahuan Desert are the following associations: Creosote-yucca-mesquite, Mesquite-grassland, and Succulent desert. The associations of the Sonoran Desert are: The Colorado River Delta, Creosote-paloverde-cacti, Sonoran-mesquite-grasslands, and the subtropical mimosaceae-cacti.

212. Brambila, M. and R. Ortiz Monasterio SOIL MAPS OF MEXICO
In: R. Ortiz Monasterio, Los recursos agrologicos de la
Republica Mexicana. Ingenieria hidraulica Mex., v.10, no.4
pp. 71-84, 1956 DLC TC1.I64

Provides official maps of soils of Mexico.

213. Botsford, C.W. GEOLOGICAL NOTES ON THE WEST COAST OF MEXICO
Engineering and mining journal, v.89 1910 pp. 223-224
DLC TA1.E56

Geologic generalization along the west coast of the State of Sonora and further south is presented. Geologic comments on the mountains of the region which consist of granite, schist, volcanics, and some sedimentary rocks included, as well as a resume of the mineralogy. Along the west coast there is a coastal plain which is 70 miles wide at Esperanza, 30 at Culiacan, 20 at Rosario, and 0 at Tepic. General narrowing of coastal plain occurs to the south. The foothill country, composed of small rounded hills rising from plains, is 100 miles in width near Guaymas, 60 miles in width near Phamos, and continues to get ever narrower towards the south.

214. Birot, Pierre THE CYCLE OF EROSION ON DIFFERENT CLIMATES. Berkeley
and Los Angeles, University of California Press, 1968 144 pp.
incl. illus. DLC QE571.B513 1968

The original text was brought up to date for this translation, the diagrams redrawn, and one new one added. The first part, basic processes of the cycle of erosion, is divided into three chapters: weathering of rocks, transport of debris on slopes, and fluvial dynamics. The second part, The Influence of Different Climates on the Cycle of Erosion, is divided under five climate types -- normal, tropical, arid and semi-arid, alternating wet and dry seasons or climates, and periglacial.

215. Beydoun, Z.R. GEOLOGY OF THE ARABIAN PENINSULA -- EASTERN ADEN PROTECTORATE AND PART OF DHUFAR US Geol. Sur., Prof. Paper 560-H, pp. H1-H49, 1966 48 ref. DLC QE79.P9

Reviews the geology shown on Geologic Investigations Map I-270A (Geologic map of the Arabian peninsula, 1963). This section includes a brief descriptive account of mountains, plateaus, plains, drainage and sand dune areas (pp. H3-H6) in eastern Aden Protectorate and part of Dhufar.

216. Bertin, B. SUMMARY OF AN EXPEDITION TO STUDY WAVELIKE FORMS IN THE SAND OF THE SAHARA (Compte rendu d'une mission pour l'etude des phenomenes ondulatoires dans le sable au Sahara.) Text in French. Inst. Recherches Sahariennes, trav., v.23, pp. 181-85 1964

Wavelike features in sandy areas of the Quargla-In Salah area are described. Some have been formed by vehicles (corrugations) and others are the work of the wind. It is noted that pebbles can be carried by the wind if the surrounding sand is all in motion.

217. Bennett, Richmond CARBON-14 DATING OF GROUND WATER IN AN ARID BASIN In: Radiocarbon and tritium dating. Proceedings of the 6th International Conference held at Washington State University, Pullman, Wash., June 7-11, 1965. Roy M. Chatters (comp.). US Atomic Energy Commission, Rept. CONF-650652 1966 (?) pp. 590-596, incl. illus. DLC CFSTI HC \$8.00; MF \$3.25

Rocks forming the mountains bordering the Tucson Basin in the Sonoran Desert of Arizona, are described. The basin is filled with Tertiary and Quaternary alluvium, and the main source of ground-water recharge is seepage from streams. The techniques for sampling and analyzing water from wells is given. The analyses show a progressively greater C-14 age as the centre of the basin is approached from a recharge area, and bring out the influence of pumping centres. This method will give the first data from which ground-water velocities and relative recharge can be determined.

218. King, Robert E. GEOLOGICAL RECONNAISSANCE IN NORTHERN SIERRA MADRE OCCIDENTAL, MEXICO Geol. soc. Amer., bull., v.50, no.11 pp. 1625-1722, incl. illus., tables, maps, 50+ refs. Nov. 1939 DLC QE1.G2

Three pages in this article discuss the geomorphology and physiography of the Sonoran desert province. Information on the stratigraphy and structure of the desert region are included in the remainder of the article. A very useful geologic map encompassing the area from 108 degrees W to 110 degrees W and 27 degrees N to 29 degrees N is provided along with small scale maps of the same area that treat the relief and tectonics. An extensive bibliography of the geology of the state of Sonora is included.

219. Hoyt, John H. AIR AND SAND MOVEMENTS TO THE LEE OF DUNES Sedimentology, 7(2) pp. 137-43, incl. illus., 1967 DLC QE471.S4

Large and extensive barchan dunes of coastal South West Africa are oriented by predominantly southerly winds. At 40-50 mi/hr, gusts lift fine sand from the downwind surface to a height of several feet; less frequently sand is picked up from a low position on the lee slope and redeposited higher. The width of the area influenced by the lee eddy during strong winds is about equal to height of the dune. Deposition on the lee slope is from sand blown over the crest, rapid deposition near the crest resulting in slumps and slides down the lee slope, and eddy currents to the lee of the dune which transport sand from the downwind surface. Observations in low dunes at Sapelo Island, Georgia, confirm the presence of a well developed lee eddy during winds of 25-50 mi/hr.

220. Humphrey, Robert R. THE DESERT GRASSLAND, PAST AND PRESENT
Jour. range mgt., v.6, no.3 pp. 159-64 May 1953
DLC SF85.J67

A study of historical and vegetational data points to the conclusion that the desert grassland of southwestern United States and northern Mexico is not a true climax. Rather, it is a subclimax maintained by fire. Today, with fires largely a thing of the past, the true climax of low trees, brush, and cacti, with an understory of grasses and low-growing shrubs is developed extensively on areas that were once grassed.

221. Hunt Charles B. PLANT ECOLOGY OF DEATH VALLEY, CALIFORNIA
US Geol. Survey, Prof. paper 509 68 pp., incl. illus.
1966 DLC QE75.P9

The composition and environment are described of stands of Lower Sonoran plants on and along the foot of gravel fans rising from the edge of the bare saltpan in the interior of Death Valley, and ranging from below sea level to the top of gravel fans and bases of adjoining mountains at 1,000 to 1,500 feet. Plant distribution is closely related to distribution of geologic formations which are more fully described in companion papers (US Geol. Survey Prof. Papers 494-A, -B). Illustrations include a map and transect of geology and plants adjacent to the Death Valley saltpan.

222. Hunt, Charles B. and Don R. Mabey GENERAL GEOLOGY OF DEATH VALLEY, CALIFORNIA -- STRATIGRAPHY AND STRUCTURE US Geol. Survey, Prof. Paper 494-A, pp. A1-A165, incl. illus., tables, geol. map, 1966

Rocks exposed in Death Valley aggregate more than 60,000 feet thick and include Precambrian metamorphic and igneous rocks, late Precambrian sedimentary rocks, Paleozoic sedimentary rocks of all periods of that era, Triassic formations, Cenozoic volcanic and sedimentary rocks and granitic intrusions. The Paleozoic and late Precambrian formations occur in thrust plates of the Amargosa thrust system, which moved younger rocks westward over older ones. Granitic intrusions spread along the thrust faults doming the upper plates. As folding and faulting continued, the magmas erupted and slabs of the upper thrust plates moved as detachment blocks into the basins. This continued during the subsequent stage of block faulting that produced Death Valley in late Pliocene and Quaternary time. Archeological evidence and tiltmeters show the deformation is continuing.

223. Ives, Ronald L. RECENT VOLCANISM IN NORTHWESTERN MEXICO
Pam Amer. geol., v.63 pp. 335-38, 1934 DLC QE1.P3

A brief article in which Ives discusses the distribution of recent lava flows in the Pinnicate region, while a picture shows a flow with a hackly, jagged surface resembling blocky or a lava. A general index map is provided, sufficient enough to locate the area of volcanism.

224. Jaeger, Edmund C. and Arthur C. Smith INTRODUCTION TO THE
NATURAL HISTORY OF SOUTHERN CALIFORNIA California Natural
History Guides, No. 13. Berkeley, University of California
Press, 1966 104 pp., incl. illus., ref. DLC QH105.C2J3

After describing the physical features, climate, and seasons of this large and diversified region, the author lists, with brief notations, the divisions of the Plant Kingdom and the phyla of the Animal Kingdom, and gives a brief explanation of taxonomy. A brief survey of life zones and biotic communities follows. The locations and characteristic plants and animals (mammals, birds, reptiles, and invertebrates) of the various biotic communities of the region are given. There is also a discussion of the balance of nature and the concept of the pyramid of numbers. A variety of nature activities are suggested, e.g. transplanting wildlings to a wildflower garden, rearing caterpillars, nature photography, making plaster casts of animal tracks, beachcombing, collecting fossils, etc. Museums and organizations concerned with natural history and the conservation of natural resources are listed, as are reference for further reading. There is a subject index.

225. Johnson, Ross B. THE GREAT SAND DUNES OF SOUTHERN COLORADO
US Geol. Survey Prof. paper 575-C, pp. 177-83, 1967 Also:
Mtn. geologist, v.5, no.1 pp. 23-29, 1968 DLC QE79.P9

The Great Sand Dunes National Monument is in the San Luis Valley of southern Colorado. Large areas of transverse, climbing dunes, barchans, longitudinal dunes, parabolic dunes of accumulation and of deflation occur in and adjacent to the Monument. They have all formed more or less contemporaneously, though different processes in different areas have created the various types. The San Juan and Sangre de Cristo Mountains are the original source of the sand; the immediate sources are the ancient natural levees and dry oxbow lakes of the Rio Grande.

226. Kam, William EARTH CRACKS -- A CAUSE OF GULLYING US Geol. Survey, prof. paper 525-B pp. B122-B125, 1965, incl. illus., 3 ref. DLC QE79.P9

The development of earth cracks accompanying land-surface subsidence that results from differential compaction of heterogeneous unconsolidated sediments favors gullyng. Such gullyng and changes in drainage pattern have been observed in Maricopa, Pinal and Pima Counties.

227. Kerr, Paul F. SALINE DEPOSITION IN THE GREAT BASIN. A PRELIMINARY LITERATURE SURVEY New York, Columbia University, Dept. of Geology, 1959 126 pp., incl. illus., tables, maps, charts, 200 ref. DLC TN903.U5G74

The first unit of a sequence of literature surveys to be supplemented by field observations which will constitute the Salines Project. The major objective of the project is to extract from the literature data which affect the mineralogy of the salines. This involves first an examination of the geological conditions which affect accumulation. To accomplish this end, saline basins, both ancient and modern, will receive attention. This will be followed by specific consideration of the mineral aggregates involved and the conditions which affect their accumulation. In order to maintain a productive sequence, the survey will be made selective rather than exhaustive. More attention will be given to classic and outstanding references and less attention to numerous references of minor consequence. Areas covered are: Bonneville Basin; Great Salt Lake; Lake County, Oregon; Lahontan Basin; southwestern basins -- Mono Lake, Mono Basin Thinolite, Rhodes Marsh, Owens Lake, Searles Lake, Panamint Valley, Death Valley, area, Boron, and Salton Sea.

228. King Philip Burke GEOLOGIC NOTE ON THE NORTHERN PART OF THE REPUBLIC OF MEXICO (Carta geologica de la parte septentrional de la Republica Mexicana.) Text in Spanish. Mexico. Universidad nacional, Inst. geol., geophys., & geod., cartas geol. y mineras, no.3, 1947, 24 pp., incl. maps

This short article, page for page, contained more valuable information than any other. The report, in brief, showed the past geologic mapping in Mexico, and whether it was detailed or reconnaissance, and maps showed the areas covered by the various workers, and whether they were large or small areas. The bibliography lists 83 references.

229. Klausen, K. et al METABOLIC REACTIONS TO WORK IN THE DESERT (MAN) Jour. appl. physiol., v.22, no.2 pp. 292-96, 1967 DLC QP1.J72

Oxygen consumption $V(O_2)$ and ventilation (VE) during submaximal and maximal work were measured in comfortable environments and in dry heat.

230. Klitzsch, E. AN EAST-WEST TRAVERSE OF THE CENTRAL SAHARA FROM THE AUENAT MASSIF ON THE SUDANESE-LIBYAN BORDER TO THE ACACUS MASSIF ON THE LIBYAN-ALGERIAN BORDER (Bericht uber eine ost-westquerung der Zentral-sahara (von Djebel Auenat an der sudanesische-libyschen grenze sum dejebel Acacus an der libysch-algerischen grenze).) Text in German with Eng. summary. Zeit. geomorph., v.11 no.1 pp. 62-92, incl. illus., map, 1967 DLC G1.Z47

The geologic and geomorphic features of the Kufra Basin, Tibesti-Sirte uplift, and Murzuk Basin of Libya are described and illustrated. The different geologic formations are very uniform over their areas of distribution and the typical landforms in these areas are dependent mainly on the lithologic character of the formations. Rock carvings and artifacts of different periods indicate that various climatic changes have occurred during the latest history of the Sahara.

231. Lacy, W.C. GEOLOGICAL CAUSES OF FOUNDATION FAILURES IN THE AREA OF TUCSON, ARIZONA Amer. Inst. Min., Metal. & Petrol. Engineers, Soc. min engineers, trans., v.229 pp. 40-44, March 1964, 11 ref. DLC TN1.A5

Urban development in semi-arid portions of the Southwest has upset a natural balance of geological conditions resulting in broad-scale and local subsidence of heaving ground conditions. Subsidence can be traced to 2 general causes; irrigation of reclaimed desert lands that have dry, low-density soils; and depression of the water table by ground-water withdrawal. Accumulation of weathered volcanic tuff produces areas with swelling characteristics. Soil and subsidence studies made in the Tucson area in Arizona illustrate foundation problems typical of the Southwest that must be considered in the design of the building codes.

232. Lattau, Katharina & Heinz BULK TRANSPORT OF SAND BY THE BARCHANS OF THE PAMPA DE LA JOYA IN SOUTHERN PERU Zeit. geomorph. v.13, no.2 pp. 182-85, incl. illus., table, ref. June 1969 DLC G1.Z47

With the major objective of providing a physical-experimental basis for an improved understanding of wind action on dry sand, the following studies were undertaken in the Pampa de la Joya area, Peru: (1) Micrometeorology of the region to determine surface stress on the desert floor and on windward slopes of well-developed barchans. (2) Aerodynamics of airflow to obtain micro-structure of air trajectories over and around typical crescent dunes. (3) Kinematics and dynamics of sand movement to determine the threshold value of surface stress for onset and termination of sand movement in situ, and the sand discharge over the crestline as a function of surface stress on the windward slope. (4) Controlled experimentation on dune modification. (5) Collection of supplementary information.

233. Leopold, A. Starker VEGETATION ZONES OF MEXICO Ecology, v.31 no.4 pp. 507-18, incl. table, map, 57 ref. Oct. 1950 DLC QH540.E3

The vegetation of Mexico is divided into 12 zones, 5 of temperate affinities and 7 of tropical. The temperate zones occupy about 70% of the land area of Mexico. Pine-oak forest, mesquite-grassland and desert are the most extensive types. Critical winter temp. (freezing) is the principal factor which differentiates the two series, and a rainfall gradient within each series largely determines the zonation into types. The pine-oak forest, with its temperate, healthy climate, suitable for the cultivation of corn, has always been the most important zone as regards to human populations. Serious impoverishment of vegetation and other natural resources has occurred there as a result of long occupation and unwise agricultural practice.

234. Logan, Richard F. CENTRAL NAMIB DESERT, SOUTH WEST AFRICA Wash. DC, National Res. Council Pub. 758, 1960 162 pp., 146 ref. DLC GB618.86.L6; DWB 551.45 L831 ce

A geographic study of the central Namib Desert in South West Africa. Topics considered are: climate, the coastal Namib, the Namib platform, the sand dunes, vegetation, animal life, human utilization of the Namib and the future of the Namib. The section dealing with the description of the climate explains the causes of the desert and distinguishes between coastal and inland climates. The effect of the Benguela Current on the coastal climate is pointed out.

235. Lootens, Douglas J. GEOLOGY AND STRUCTURAL ENVIRONMENT OF THE SIERRITA MOUNTAINS, PIMA COUNTY, ARIZONA Ariz. geol. soc. digest, v.8 pp. 33-56, incl. illus., 1966 DLC unbound

The Sierrita Mountains were mapped in detail, with special attention to areas of significant structural interest and their relation to mineralization. Structural elements defined include (1) post-volcanic, pre-intrusive east-west compressional force producing northwesterly-trending, high angle wrench faults, (2) a similar post-intrusive east-west compressive episode producing northeasterly trending wrench faults, and (3) domal uplift with intrusive emplacement which tilted the volcanics and produced north-trending faults east of the range. Mineralization ranges from extensive porphyry copper-type concentrations to small high-grade veins of lead, copper, silver, and gold.

236. Howard, William A. and Thomas M. Griffiths
TRINCHERA DISTRIBUTION IN THE SIERRA MADRE OCCIDENTAL
Denver, Univ. Dept. Geogr., Pubs. in geogr., tech. paper 66-1
1966 95 pp., incl. illus., 39 ref. DLC F1261.D4 no. 66-1

These stone terraces and check dams have greatly influenced the physical environment of the area. They were built to conserve soil and moisture. Modern examples have been found constructed by a lumber company to control erosion in a small stream. It is concluded that while trincheras have certainly had some effect on the morphology of the area, they have not been able to prevent denudation as Leopold suggested. They were mapped by field investigation over an area of 11,200 square miles. Geology, climate and vegetation are described, and the main chapter describes the distribution of these features, together with various cave and rock dwellings which in some cases are associated with trincheras.

237. Holm, Donald August DOME-SHAPED DUNES OF CENTRAL NEJD, SAUDI ARABIA In: Internatl. geol. cong., 19th Algiers, 1952, comp. rend., sect. 7: Current and ancient deserts pp. 107-112, + illus., Algiers, 1953 DLC QE1.I6 1952b

Dome-shaped dunes, common in the nefud of north central Nejd, appear to be a form unique to the Arabian Peninsula. These differ in origin and form from the ubiquitous barkhan dune of many sand deserts, in being shaped like a broad symmetrical dome as the result of highly varying wind directions and intensities. Crescentic dunes, however, form a minor surface expression on the larger and more complex dome-shaped dunes. In each of the several nefud of the Nejd, the dome-shaped dune dominates the form and pattern. The pattern includes deflation hollows arranged in belts surrounding the domes. roughly radial sand ridges arranged about the flanks of the domes and separating the deflation hollows, and a pattern which appears to be the result of deflation, in which the domes have been reduced to low ridges oriented north and south, separated by broad low expanses of hard packed sand. The long range movement of sand appears to be from west to east, indicated by massing of dunes on the north east margins of the nefuds.

238. Holm, D.A. DESERT GEOMORPHOLOGY IN THE ARABIAN PENINSULA Science v.132, no.3437 pp. 1369-79, incl. illus., map, ref. Nov. 11, 1960 DLC Q1.S35

The topographical features of the Arabian Peninsula are described and illustrated by aerial photographs. About 30% of the 1,060,000 sq. mi. is covered by sand. The sand occupies areas of low relief. The area has a complex wind regime; thus the dunes show a great diversity of shape and size. Gravel plains are very extensive, and these were, in part, deposited in wetter Pleistocene times. Sabkhahs (saline flats) are often disguised by a thin cover of sand or silt, and are hazardous for vehicles. Their origin is discussed. A number of canyons cutting through the central Tuwaig escarpment are wider at the western rather than eastern ends, suggesting stream flow contrary to the present eastward direction.

239. Furon R. GEOLOGY OF AFRICA Translated from the 2nd French ed. Edinburgh, Oliver and Boyd, 1963 377 pp. DLC QE320.F813

A basic guide to the geologic literature of Africa, with regional divisions making it convenient to locate specific arid areas.

240. Gile, Leland H. A CLASSIFICATION OF CA HORIZONS IN SOILS OF A DESERT REGION, DONA ANA COUNTY, NEW MEXICO Soil sci. soc. Amer., proc., v.25, no.1 pp. 52-61, incl. illus., tables, 16 ref. Jan.-Feb. 1961 DLC S590.S64A13

A Ca horizon is defined in the Soil Survey Manual as an accumulation of calcium carbonate. Field study in Dona Ana County shows that Ca horizons occur in soils on a variety of sediments and geomorphic surfaces. A broad fan piedmont extends from the Rio Grande Valley eastward to the igneous Organ Mountains. To the N is a desert bolson. In soils on these surfaces and in paleosols underlying the fan peidmont, Ca horizons occur and range from thin CaCO_3 filaments or coatings on pebbles to indurated horizons many feet thick. In soils of Dona Ana County, Ca horizons have been classified as weak, moderate, strong, and very strong. The classification is based on field morphology, CaCO_3 equivalent, particle size, bulk density, unconfined compressive strength, and infiltration rate.

241. Gile, Leland H. CAMBIC AND CERTAIN NONCAMBIC HORIZONS IN DESERT SOILS OF SOUTHERN NEW MEXICO Soil sci. soc. Amer., proc., v.30, no.6 pp. 773-81, incl. illus., tables, 1966 DLC S590.S64A13

Horizons in B position may be ordered in degrees of increasing development forming continuous series closely related to age. Freshly deposited arroyo alluvium contains no evidence of soil development. Very weak soil development becomes apparent with increasing age, then cambic horizons and finally argillic horizons occur in B position. Distinct cambic horizons have formed in soils less than 5,000 years old, with parent materials altered sufficiently to destroy fine strata, form structure, develop redder color, redistribute carbonate, or accumulate slight amounts of silicate clay. Older soils show evidence of greater changes in the B position. Argillic horizons apparently formed in some soils and were later destroyed, and some once had much thicker B horizons than now. Evidence indicates Pleistocene pluvials were wetter and cooler than at present.

242. Gile, Leland H. and J.W. Hawley PERIODIC SEDIMENTATION AND SOIL FORMATION ON AN ALLUVIAL-FAN PEDIMENT IN SOUTHERN NEW MEXICO
Soil sci. soc. Amer., porc., v.30, no.2 pp. 261-68, 1966
DLC S590.S64A13

Gullies cut in alluvial-fan piedmont at the southern end of the Jornada del Muerto Basin show a succession of four major sediments, each having a distinct soil. Toward the basin axis the sediments thin and there is mergence of the land surface soil with the oldest. The land-surface soils overlie much older rocks and in places are so thin that the buried soils must be considered in their classification. Gradual mergence zones of sediments, and filling of old channels by younger sediments can cause major soil changes not suggested by the smooth relief and uniform slope which crosses the soil boundaries.

243. Gile, L.H., F.F. Peterson and R.B. Grossman MORPHOLOGICAL AND GENETIC SEQUENCES OF CARBONATE ACCUMULATIONS IN DESERT SOILS
Soil sci., v.101, no.5 pp. 347-60, incl. illus.
DLC S590.S6

Authigenic carbonate horizons of many desert soils of southern New Mexico have formed in thick well-drained alluvium. Carbonate horizons formed in gravelly sediments display a different morphological sequence with continued accumulation of carbonate as compared with horizons formed in non-gravelly sediments. In latest stages, the sequences converge on a common overall morphology in which a laminar horizon overlies a carbonate-plugged K-horizon. The sequence on gravelly sediments can be completed on late Pleistocene age surfaces. In many soils on older surfaces the carbonate horizon morphology suggests more than one major cycle of carbonate accumulation.

244. Giletti, Bruno J. and Paul E. Damon RUBIDIUM-STRONTIUM AGES OF SOME BASEMENT ROCKS FROM ARIZONA AND NORTHWESTERN MEXICO
Geol. soc. amer., bull., v.72, no.4 pp. 639-43, incl. table, map, 12 ref. April 1961 DLC QE1.G2

Precambrian ages in the range 1,200-1,500 m.y. have been found by the Rb-Sr method for basement rocks in Arizona. The data extend the "1,350 m.y." orogeny to northwestern Arizona (Chloride granite) and southern Arizona (Oracle granite) near Tucson. Cretaceous-Tertiary ages were obtained from basement rocks in southern Arizona and northern Sonora, Mexico.

245. Girinskii, N.K. CERTAIN SPECIFIC FEATURES OF THE DYNAMICS OF UNDERGROUND WATERS OF DESERTS AND SEMI-ARID LANDS Text in Russian. Internatl. geol. cong., 20th Mexico, 1956, proc., Part 4: pp. 31-48, 1957 DLC QE1.I6 1956b

1 -- In desert and semi-arid regions there are: a) fresh waters mainly derived from atmospheric water and surface waters from floods, and b) salt waters -- by evaporation of underground waters and by solution of previously formed salts. In these regions there can also be waters formed in other areas which migrated along permeable rocks. 2 -- On the contact of waters with different mineralization, a transition zone is formed as a result of their intermixing, or through other processes. Waters of different mineralization occupying vertical positions according to their specific gravity, can move in opposite directions. Consequently, with the presence of fresh water lenses in moving salt waters, the surface of underground water can have a knobby aspect. 3 -- A joint stabilized movement of fresh waters of sea coasts. 4 -- Elementary transcendental functions demonstrate the following cases: a) a head pressure stream in a horizontal or inclined bed; b) a free surface stream in a horizontal bed, when the intensity of the intake of the stream from above is W-OW. 5 -- Investigations of a joint unstabilized movement of fresh and saline waters is simplest done by a method of finite difference.

246. Glendenning, G.E. SOME QUANTITATIVE DATA ON THE INCREASE OF MESQUITE AND CACTUS ON THE DESERT GRASSLAND RANGE IN SOUTHERN ARIZONA Ecology, v.33, no.3 pp. 319-28, incl. illus., tables July 1952 DLC QH540.E3

Remapping, in 1949, of two sample plots established on the Santa Rita Experimental Range in 1932, has yielded quantitative data on changes in abundance of velvet mesquite and four species of cactus and in density of perennial grasses under three grazing treatments during the period 1932-1949. Results showed that mesquite more than doubled in number and crown area while perennial grass density decreased more than 95% under all grazing treatments. Rapid encroachment of several species of cactus which are adapted to the use of temporarily available surface moisture accompanied the increase in mesquite.

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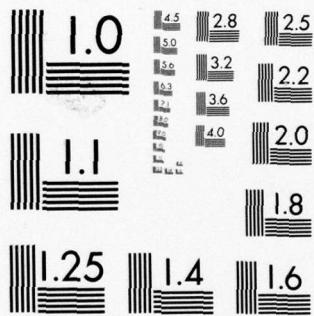
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

247. Gold, D.B. THE CACTACEAE OF THE STATE OF CHIHUAHUA, MEXICO
(Las cactaceas del Estado de Chihuahua) Text in Spanish
Cacataceas y succulentas Mexizanas, v.11, no.3 1966
pp. 65-67

Species of cacti listed are: Peniocereus, Thelocactus,
Mammillopsis, Coryphantha. Besides the cacti there are num-
erous species of Agave, Dassylirion, Yucca, and several
Escheveria, Pachyphytum, and Sedum.

248. Gold, D.B. GEOGRAPHY OF THE MEXICAN CACTUS ZONES (Geografia
de las zonas cactologicos mexicannas.) Text in English
Cactaceas y succulentas Mex., v.12, no.2 pp. 27-30,
incl. map, 1967 DNAL

-- not seen --

249. Gomez-Pomoa, A. THE VEGETATION OF MEXICO (La vegetacion de
Mexico) Text in Spanish Soc. Bot. Mex., bol., v.29
pp. 76-120, 1965 DLC QK1.S749

Miranda and Hernandez paper (1963) was the main source for
describing the types of vegetation. Three main climatic types
are distinguished: temperate or fold; arid or subarid; and
hot.

250. Green, Christine R., and Martin S. Clark EVALUATION OF PRECIPI-
TATION, VEGETATION AND RELATED FACTORS ON THE SANTA RITA
EXPERIMENTAL RANGE Arizona. University Inst. Atmos. Phys.,
Tech. repts. on meteorol. and climatol. of arid regions
No. 17, April 1967 82 pp., incl. illus., tables, ref.
DLC QC993.7.T4 AD 177 135

Monthly and annual precipitation data for 45 rain gages over
the Santa Rita Experimental Range are presented in this pub-
lication. A common 26 year period for 22 of the gages is
used in statistical analyses. The results are tabulated and
presented graphically. The effectiveness of precipitation
on vegetation and soil moisture in the area is discussed.
Tables and graphs depict the typical effects to be found with-
in the Experimental Range.

251. Greenwood, J.E.G.W. and D. Bleackley GEOLOGY OF THE ARABIAN
PENINSULA, THE ADEN PROTECTORATE US Geol. Survey, Prof.
paper 560-C, pp. C1-C96, 69 ref., 1967 DLC QE79.P9

An account of the geology of the Aden Protectorate based on photo-geological interpretation and field survey, which includes a survey of the major relief features in the area and a discussion of the Aden Volcanic series of late Miocene or Pliocene to Recent age. Four physiographic zones are distinguished. (1) The Coastal Plain is composed of marine, fluvial, aeolian and volcanic deposits resting on a post-Miocene marine bench. (2) The Ramped Plateaus, behind the Coastal Plain, include various planation and depositional surfaces which have been dissected. Many wadis in the area are fringed by pediments. (3) The Sand Desert and Gravel Plain occupy the central area of the Arabian Peninsula and are composed of extensive dune-fields and gravel spreads which are generally on pediplain surfaces of low relief. (4) The Plateau area in the northeast is composed of a tableland capped by mesas and cuestas of Eocene rocks; many wadis are developed in this area.

252. Groot, J.J. and C.R. Groot AN ANNOTATED BIBLIOGRAPHY ON THE
ENVIRONMENT OF DESERT AND SEMI-DESERT AREAS OF WESTERN
AFRICA US Army Quartermaster Res. and Develop. Branch,
Environmental Protection Ser. Rept., 128, 1948 96 pp.

(not seen)

592 references are provided. Regional studies include Algeria, Mauritania, Niger, Sudan. Other topics: bibliographies, geology, landforms, hydrography, itineraries and transportation problems, climate, flora and fauna, agriculture, ethnography, and health.

253. GUIDEBOOK TO THE GEOLOGY AND HISTORY OF TUNISIA Libya, Petroleum
Exploration Society, 9th annual field conference, 1967
293 pp. DLC

This well illustrated guidebook contains two articles of direct geomorphic interest, and 1:1,000,000 maps of tectonic elements and geomorphic provinces of Tunisia. Also included are three papers on Tunisian history, ten papers on geology, stratigraphy and tectonism, and a road log covering about 1240 km of travel. Of special interest is a brief glossary giving the English equivalent of over 40 Arabic geographic terms.

254. Guven, Nicep and Paul F. Kerr SELECTED GREAT BASIN PLAYA CRUSTS
Amer. mineralogist, v.51, no.7 pp. 1056-67, incl. illus.,
tables, 1966 DLC QE351.A7

Mineralogical studies of samples from Deep Springs Playa, California; Mud Lake and Humboldt Playas, Nevada; Sevier Playa, Utah; and the Animas Playa, New Mexico; indicate that the mica-type clay minerals illite, vermiculite, and montmorillonite are prominent in the playa crusts. The clay minerals display strong continuous scattering accompanying the normal Bragg reflections, presumably caused by intensive structural disorder due to weathering. The existence of sensitive layers like those of vermiculite and montmorillonite in the playas is important in explaining the physical behavior of the surface of the playas. These layers exfoliate when dried and also expand with an increase in humidity.

255. Hagedorn, H. LANDFORMS OF THE TIBESTI REGION In South
central Libya and northern Chad. Libya, Petroleum Explor-
ation Society, Annual Field Conf., 8th, 1966, pp. 53-58

The Tibesti mountains, composed chiefly of great cones and lava flows, form the highest relief element of the Sahara. A high zone showing periglacial-fluvial features, an intermediate arid zone of fluvial features, and a low zone of eolian features are the three zones described.

256. Hall, D.N. A SIMPLE METHOD OF NAVIGATING IN DESERTS Geogr.
jour., v.133, pt.2 pp. 192-205, incl. illus., graphs,
tables, 6 ref. June 1967. Also FURTHER NOTES ON NAVIGAT-
ING IN DESERTS Ibid, v.133, pt.4 pp. 508-11, Dec. 1967
DLC G7.R91

With a working knowledge of a particular, but limited method of navigation the desert worker can break away from the beaten track, and so cover interesting new areas. Two techniques are described. One is dead reckoning (D.R.) on the move, which can be achieved for direction by sun compass, and for distance by millimeter. The second is the ability to obtain a rough position fix from heavenly bodies, requiring only an instrument for measuring angles of elevation from the horizontal, the exact time, and two books of tables.

257. Hawley, John W. and Leland H. Gile LANDSCAPE EVOLUTION AND
SOIL GENESIS IN THE RIO GRANDE REGION, SOUTHERN NEW MEXICO
-- FRIENDS OF THE PLEISTOCENE, ROCKY MOUNTAIN SECTION, 11th
ANNUAL FIELD CONFERENCE, AUGUST 1966, GUIDEBOOK Las Cruces,
New Mexico, New Mex. State Univ., 74 pp., incl. illus.,
tables, 1966

This guidebook covering the 400 sq mi area of the Desert Project in southern New Mexico is divided into a section on geomorphology by Hawley, another on soils and soil-geomorphic relationships by Gile, and a tour guide, with 80 mi of road log and comments on 17 stops, by both authors. Eleven major geomorphic surfaces dating back to mid-Pleistocene are delineated; stepped-sequence of surfaces is shown on sections and each is described in detail. Soils are complex in nature and distribution, due to their great range in age, and the K horizon, a new master horizon for soils of prominent carbonate accumulation, is defined and divisions described. Stages in the morphological sequences of carbonate accumulation in gravelly and nongravelly materials, and convergence of the sequences, are discussed. Tables of selected data for soils and sections showing relationships are included.

258. Fischer, Heinze THE WHITE SANDS GYPSUM DESERT, NEW MEXICO,
USA ('The White Sands,' die gipswüste in New Mexico, USA)
Naturwiss, rundschau, v.20, no.10 pp. 426-32, 1967
DLC Q3.N8

A general discription of the erosional landforms and surface deposits of the White Sands National Monument area, a gypsum desert near Alamogordo, New Mexico. This area is in a valley between Front Ranges of the Rocky Mountains and is not entirely without water; precipitation and mountain runoff disappear rapidly in a sea of wind-rippled dunes of fine gypsiferous sand, leaving only a salty swamp, Lake Lucero. Powdered gypsum dust forms large selenite crystals which are easily split into thin sheets; large crumbs of plaster of paris are widespread in the park.

259. Fletcher, Joel E. and Paul H. Carrol SOME PROPERTIES OF SOILS ASSOCIATED WITH PIPING IN SOUTHERN ARIZONA Soil sci. soc. amer. proc., v.13 pp. 545-47, incl. illus., 1948
DLC S590.S64A13

Three types of "piping" erosion were studied. The first is the result of lateral flow along a subsoil to an open bank, the second is the result of surface water running into cracks in the upper subsoil thus washing tunnels to the outlet, and the third is the result of dispersed surface soil being washed into the pores of the coarse poorly graded upper subsoil, causing sinking and caving. The necessary condition in all cases is that the surface soil infiltrates water faster than the subsoil, giving lateral flow. The soil properties which correlated with this phenomena are pH, soluble salts, and exchangeable Na.

260. Fletcher, Joel E. and others SYMPOSIUM OF LAND EROSION: "PIPING" Amer. geophys. union, trans., v.35, no.2 pp. 258-62, incl. tables, illus., 6 ref. 1954 DLC QE500.A6

It is postulated that the five following conditions must be present before piping can take place: (1) There must be a source of water. (2) The surface infiltration rate must exceed the permeability rate of some subsurface layer. (3) There must be an erodible layer immediately above the retarding layer. (4) The water above the retarding layer must be under a hydraulic gradient. (5) There must be an outlet for the lateral flow. These postulates were tested by detailed studies on five of the principal piping areas of Arizona: Picacho, Dateland, Roll, San Pedro and Whitewater Draw areas. It was found that all were present on each area. In the Picacho area, the pipes (pipe-like channels) extend from several playa-like areas toward a shallow entrenched drainage way. At points where these intersect the highway and railroad they appear to be large cracks in the soil surface.

261. Forbes, Robert H. THE EXPANDING SAHARA Ariz., Univ. Bull (Phys. sci. bull. no.3), v.29, no.5 28 pp., incl. maps, illus. October 1958 DLC GB361.S3F6

This article briefly discusses both the natural and human conditions that have contributed within recent time towards the extension of the Sahara Desert southward.

262. Felton, Ernest L. CALIFORNIA'S MANY CLIMATES. Palo Alto,
Pacific Books, 1965 169 pp., incl. maps DLC QC984.C2F4

A semi-technical discussion of California climates. Desert conditions are recognized to occur in the upper San Joaquin Valley; and desert regions described include the Antelope, Death, Colorado River, Coachella, Imperial, Borrego, and Palo Verde Valleys, and the Mojave Desert. Typical temperatures and precipitation are listed for each.

263. Fett, John D., Douglas H. Hamilton, and F.A. Fleming
CONTINUING SURFACE DISPLACEMENTS ALONG THE CASA LOMA AND
SAN JACINTO FAULTS IN SAN JACINTO VALLEY, RIVERSIDE COUNTY
CALIFORNIA Eng. geol., v.4, no.1 pp. 22-32, 1967
DLC

Evidence of surface displacement and differential elevation changes related to movement along the San Jacinto and Casa Loma faults includes the escarpments in Recent sediments along the faults, a history of recurrent cracking, offsetting, repairing and regarding of roads across faults, formation of sink holes in alluvial sediments along parts of the faults, and comparative leveling data showing subsidence of the block between the two faults. Observed movements along these faults and down-dropping of the San Jacinto Valley may be attributable to the effects of ground-water withdrawal from the pressure aquifer underlying the valley. The possibility exists that the fault movements are part of a continuation of tectonic processes responsible for the origin and development of the San Jacinto Valley.

264. Wallace, R.E. and R.M. Moxham USE OF INFRARED IMAGERY IN
STUDY OF THE SAN ANDREAS FAULT SYSTEM, CALIFORNIA
US Geol. Survey, Prof. paper 575 D, pp. D147-D156, incl.
illus., ref., 1967 DLC QE75.P9

Infrared imagery (in the 8- to 13-micron band) of the San Andreas fault system in the Carrizo Plain area of California shows that the fault can be clearly traced over most of about 200 miles flown. Variations in soil moisture caused by the water barrier characteristics of the fault zone, as well as vegetation differences related to soil moisture and micro-topography, are factors influencing visibility of the fault in the IR imagery. Also identified on the imagery and useful in analysing offset on the fault are; 1) offset segments of ancient stream channels disrupted by movement on the fault, 2) landslide terrain, and 3) numerous soil and tertiary bed-rock units. Imagery obtained 1-2 hours before sunrise is considered most useful for the fault studies.

265. Wallen, C.C. FLUCTUATIONS AND VARIABILITY IN MEXICAN RAINFALL
In: Gilbert F. White (ed.), The future of arid lands.
Washington DC, American Association for the Advancement
of Science, 1956 pp. 141-55, 6 ref. DLC GB665.A55

After briefly discussing the most important meteorological research problems to be studied in desert areas, the author analyzes the fluctuation and variability of Mexican rainfall. The areal characteristics of precipitation and the circulation factors associated with Mexican precipitation, long term fluctuations in maximum rainfall amounts, and the relationship between rainfall variability and agriculture are discussed. Isohyetal charts showing mean annual precipitation (1919-1953); the relative interannual variability of precipitation, isonormals of relative variability of annual precipitation anomalies with normal world distribution of relative variability of precipitation, etc., are presented.

266. Weidie, A.E. and G.E. Murray GEOLOGY OF PARRAS BASIN AND ADJACENT AREAS OF NORTHEASTERN MEXICO Amer. assoc, petrol. geologists, bull., v.51, no.5 pp. 678-95, May 1967
DLC TN860.A3

The Parras Basin contains 4500 to 6000 m of upper Cretaceous and lower Tertiary terrigenous sedimentary rocks. Fifteen hundred to 2100 m of Lower Cretaceous carbonate rocks and 2000 to 3000 m of Triassic and/or Jurassic sedimentary rocks exhibit complete facies relations. Lower Cretaceous carbonate rocks are remarkably uniform in large areas of northeastern Mexico. The type of degree of deformation within the Parras basin are not uniform as indicated by three factors.

267. Weight, Marie L., and Edgar J. Seltzman AN ANNOTATED BIBLIOGRAPHY OF CLIMATIC MAPS FOR MEXICO Wash., US Weather Bur., Rept. No. WB/BM-59, Oct 1963 30 pp. AD 660 829

The bibliography of climatic maps consist of sources in the Weather Bureau Library, the Library of Congress and the US Oceanographic Office Library. The area includes not only Mexico but Central America as well. 82 references are listed.

268. Thorp, M.B. SOME ASPECTS OF THE GEOMORPHOLOGY OF THE AIR MOUNTAINS, SOUTHERN SAHARA Inst. Brit. Geographers, Trans., V.47 pp. 25-46, incl. illus., ref., 1969 DLC G7.I6

The paper introduces some of the main features of the geomorphology of the Air Mountains, situated in the Niger Republic south of the Hoggar. The Air may form a valuable link in the interpretation of arid and humid west African landforms and provides an interesting case study in Saharan geomorphology.

269. Thrower, Norman J.W. SYSTEMATIC CADASTRAL SURVEY In: Leestma, R.A., and R.A. White (eds.) Earth resource surveys from space. V.1 Houston, NASA Earth Resources Group, pp. D3-D4 1966

A photograph giving a broad view northeastward across the Sonoran Desert, including much of the arid section of California with smaller areas of Arizona, Nevada, and Mexico, is interpreted. Physiographic provinces shown are the inland extremity of the California Coast Ranges and the southern extremity of the Basin and Range region. Most prominent features are the Salton Sea and the irrigated Imperial Valley.

270. Townsend, Robert EXPLORING PINICATE Desert, v.31, no.5, 1968 pp. 30-31 DLC F786.D47

Ten (10) volcanic craters in the Pinicate Mountains of northwestern Sonora, Mexico, are briefly described.

271. Tuan, Yi-Fu NEW MEXICAN GULLIES: A CRITICAL REVIEW AND SOME RECENT OBSERVATIONS Assoc. Amer. Geographers, ann., v.56, no.4 pp. 573-97, incl. illus., 36 ref., 1966 DLC G3.A7

Gullies cut in alluvial fill are common features of the New Mexican landscape, and are most conspicuous in a semi-arid upland environment. The paper is concerned with types of gullies and their regional setting, comparison of modern gullies, changes in form and depth since the late 19th Century, and problems of environmental interpretation. Alluvial fill, erosional conditions, pollen record and climate are briefly considered, and two environmental models are evaluated. The one designated the Martin-Schoenwetter model is favoured in that gullying is regarded as the result of an increase in the number and energy of summer rains, and that is supported to some extent by recent observations.

272. Terjung, Werner H. ANNUAL PHYSIOCLIMATIC STRESSES AND REGIMES
IN THE UNITED STATES Geogr. rev., v.57, no.2 pp. 225-40,
incl. tables, 1967, 6 ref. DLC G1.G35

In an attempt to quantify the ideas of climatic stress and degree of temperateness, three annual indices are proposed: (1) Cumulative stress, which measures the relative departures from the human state of comfort; (2) of heat stress in relation to cold stress; and (3) annual physioclimatic regime, which regionalizes these considerations on a dynamic and genetic basis. Some conclusions indicate that the Hawaian Islands and the Southwest, South, and Southeast exhibit least stress, in spite of the oppressive summer conditions in the last two. For almost the entire country cold stress is of greater importance than heat stress, as is indicated also by the vast areal extent of the various subdivisions of "keen" regimes, of which a great variety was observed. Classifications utilizing averages and parameters that have little influence on human physiology are not perceived as climatic entities by man.

273. Terjung, Werner H. PHUSIOLOGIC CLIMATES OF THE CONTERMINOUS
UNITED STATES: A BIOCLIMATIC CLASSIFICATION BASED ON MAN
Assoc. Amer. Geographers, ann., v.56, no.1 pp. 141-79,
incl. maps, tables, March 1966 DLC G3.A7

Four physiological and psychological reactions of man to temperature, relative humidity, wind chill, and solar radiation are combined into two nomograms from which average human reactions can be deduced. Comfort and wind effect indices are applied to meteorological data of the conterminous United States for July and January, daytime and nighttime, respectively. Maps combining both indices for July apply the classification on a larger scale (Southern California), and on a smaller scale (US). A map of annual physio-climatic extremes synthesizes in a generalized form results which attempts to revise certain conventional notions about comfort regions. No paradoxical distributions are apparent and the classification seems limited only by the availability and reliability of data. The scheme is applicable to any dimension time or region, and is considered a contribution to medical geography, climatological education, tourism, military geography, housing, clothing, and a general analytical tool, introducing greater precision into geography.

274. Tevis, Lloyd, Jr. UNSUCCESSFUL BREEDING BY DESERT TOADS (BUFO PUNCTATUS) AT THE LIMIT OF THEIR ECOLOGICAL TOLERANCE
Ecology, v.47, no.5 pp. 766-75, incl. illus., ref., Late
summer 1966 DLC QH540.E3

Survival and reproduction of a linear population of Bufo punctatus was studied during 1964 in an often waterless, mile-long section of a canyon of the Colorado Desert of California. Reproduction had been unsuccessful in earlier years of record because of little or no spring flow and infrequency of summer flashfloods. Nearly all tadpoles were killed by desiccation both in spring and summer. Since some toe-marked adults were captured after 4 years, longevity may be a reason for survival of populations in severe habitats where successful reproduction is rare.

275. Thayer, W.N. THE PHYSIOGRAPHY OF MEXICO Jour. geol., v.24
pp. 61-94, 1916 DLC QE1.J8

The author divides Mexico into its physiographic provinces but on a rather simplified basis. The provinces of interest to the current study are the Anahuac Desert (Chihuahuan Desert) and the Sonoran Desert. The article is very sketchy and one of the early efforts at physiographic subdivisions. If no better information is available, the section on the geology of the Sonoran Desert may be helpful.

276. Thomas, B.E. TRANSPORTATION AND PHYSICAL GEOGRAPHY IN WEST AFRICA Washington DC, National Academy of Sciences-National Research Council, Div. Anthropology and Psychology, Human Environments Central Africa Project, 1960, 54 pp., incl. maps
AD 236 244

Includes a chapter on the Sahara with a discussion of travel conditions for motor and camel caravans over various terrains including ergs, regs and hamadas.

277. Sumner, John S. THE UNIVERSITY OF ARIZONA'S GRAVITY PROGRAM
IN ARIZONA Amer. geophys. union, trans., v.46, no.3
pp. 560-63, incl. illus., March 1965 QC8511.J6

Unitl recently there were only 14 recorded high-accuracy gravity bases in Arizona; 50 more have now been established. The location of the regional gravity bases set up during the past year are shown in a sketch map. Another map shows the plan of the Mt. Lemmon gravimeter calibration range near Tucson. Other recent gravity surveys in Arizona by the University of Arizona and by the US Geological Survey, are outlined. An analysis of earth-tide observations in the Tucson area during establishment of the regional bases showed anomalies in behaviour compared with theoretical amplitudes and values observed at LA California, and Austin, Texas.

278. Sykes, Godfrey THE CAMINO DEL DIABLO, WITH NOTES ON A JOURNEY
IN 1925 Geogr. rev., v.17 pp. 67-74, 1927 DLC G1.G35

The Camino del Diablo follows closely the US-Mexican border and is probably the most difficult and dangerous route in the Papago country. Lack of water is one of the primary reasons for the difficulty of passage and an excellent example of the physiological effects of the lack of water in the desert are cited in detail. Several photographs of the terrain are included.

279. Tarbet, L.A. IMPERIAL VALLEY Amer. assoc. petrol. geologists,
v.35, no.2 pp. 260-63, incl. graph, map Feb. 1951
DLC TN860.A3

The basement complex in the Imperial Valley is composed of pre-Tertiary metamorphic rocks intruded by granite and pegmatites similar to the rocks exposed throughout the Southern Mountain region on the west. The sidiments in the valley are subdivided into the following 5 formations: (1) The Split Mt. formation (Miocene?); (2) the Alverson Canyon formation (Miocene?); (3) the Imperial formation (Miocene); (4) the Palm Springs formation (Miocene or Pliocene or both); and (5) the Borrego formation (lower Pliestocene?). These are described briefly. Structurally, the valley is a series of parallel fault blocks, including the San Jacinto and San Andreas faults. The sediments are strongly folded in two structural alignments, one subparallel with the major faults and another trending east-west.

280. Tator, Ben A. PEDIMENT CHARACTERISTICS AND TERMINOLOGY.
PART I: PEDIMENT CHARACTERISTICS Assoc. Amer. Geographers
ann., v.42, no.4 pp. 295-317, Dec 1952, 43 ref. PART II:
TERMINOLOGY Ibid., v.43, no.1 pp. 47-53, March 1953
DLC G3.A7

Planate bedrock surfaces, rock pediments and rock benches, form a large proportion of the comparatively flat relief elements of arid and semiarid landscapes. Analysis of the published descriptions of pediments reveals the apparent universal nature of some of their physical characteristics. Attention is focused on such diagnostic criteria. The terminology generally used to designate the erosion surface is examined with the aim to select the most appropriate terms. A summary tabulation of 43 works pertinent to the subject is listed in an appendix, a number of which treat the Sonoran Desert region.

281. Tator, Benjamin A. THE CLIMATIC FACTOR AND PEDIMENTATION
In: Internatl. geol. cong., 19th, Algiers, 1952, compt.
rend., Sect. 7 pp. 121-30, 2 ref., Algiers, 1953
DLC QE1.I6 1952b

Although planation may occur in any climatic regime (non-frigid), its most widespread representative, the pediment, reaches maximum development in the dryland setting. The erosional rock bench and the pediment are genetically similar, definition being a matter of areal extent and topographic restriction. It is the relatively dry atmospheric combination which contains the most efficient means for extensive leveling of the bedrock over a relatively short time interval. No special physical or chemical process of rock decay (or erosion) is exclusive to the dry land setting. It is the intensification of the more physical processes decrease in efficiency with increase in atmospheric moisture, largely because there is an increase in the stability of slopes in this direction. In this respect it should be noted that extended rock planation cannot occur, regardless of the climatic setting, unless the runoff is capable of removing the debris of weathering.

282. Samano Pineda, Carmen THE SOILS OF MEXICO (Los suelos de Mexico) Mexico (City), Universidad nacional, anuario geograf. 1965, v.5 pp. 65-125, incl. illus., tables, 1966

The principles of the genetic processes in development of different soil types and zones are reviewed briefly, and a number of classifications of Mexican soils, made between 1937 and 1964, are grouped to compare nomenclatural differences. The surface areas of the various types found in each state are tabulated. Maps of different years, reproduced here on a scale of about 240 km per inch, differ considerably in distribution of soils and in nomenclature; a larger map, 100 km per inch, differs from them even more. The effects of erosion and land use are considered by percentage according to climatic zones and physiographic regions.

283. Sanders, E.M. THE NATURAL REGIONS OF MEXICO Geogr. rev., v.11, no.2 pp. 212-26, incl. maps, April 1921 DLC G1.G35

In this article covering the geography of all of Mexico, the Sonoran desert is designated as the northern part of the land on the eastern side of the Gulf of California, which provides an interesting example of erosion in an arid climate. The surface consists of a series of plains, broken by buttes, mesas, and sierras, which are probably the worn-down stumps of parallel, northwest-trending chains of mountains. The plains on close inspection prove to be basins, and as one passes inland, each succeeding basin lies higher than its neighbor, the altitude gradually increasing from sea level to 3500 feet. The vegetation is characterized by its discontinuity. There are wide stretches where there is no vegetation, alternating with areas where there is sufficient water and soil to support the growth of cactus and spiny scrub. Mesquite, palmo verde, and the Sonoran greasewood are the chief arborescent forms, but it is the cactus that is the most striking feature. There is a map of Sonora and Chihuahua.

284. Schmidli, Robert J., P.C. Kangieser, and R.S. Ingram
CLIMATE OF PHOENIX, ARIZONA US Weather Bur., Western
Region Tech. Memo. WBTM WR 38, April 1969, 51 pp.
DAS (M(055) U587wet)

Provides a general description of the geography and climatology of the area, summarizes the region's weather, by months, and outlines the history of area weather observations since the mid-nineteenth century. Data in tabular form comprises times of sunset and sunrise; extensive temperature observations, including freeze and growing season data; precipitation; occurrence of thunderstorms, hail, and tornadoes; sunshine, cloudiness and fog; wind, including speed, direction, and peak gusts; pressure; flying weather; holiday weather information; and weather extreme.

285. Sharp, R.P. SAN JACINTO FAULT ZONE IN THE PENINSULAR RANGES
OF SOUTHERN CALIFORNIA Geol. soc. Amer., bull., v.78,
no.6 pp. 705-29, June 1967, map DLC QE1.G2

The San Jacinto fault zone is one of the major branches of the San Andreas fault system. Straightness, continuity, and the high seismicity of this zone, as well as its present right-lateral strain rate, suggest that currently it may be the most active member of the system in this region. Major fractures and displacements on the San Jacinto fault zone are described.

286. Shreve, Forrest VEGETATION OF THE NORTHWESTERN COAST OF MEXICO
Torrey Bot. Club, bull., v.61 pp. 373-80, 1934 DLC QK1.T6

The most arid region in North America lies along the lower course of the Colorado River and on both sides of the head of the Gulf of California. In portions of this region Larrea tridentata and Fraseria dumosa form 98% of the vegetation but often cover only 4 to 15% of the ground surface. The less frequent plants are confined to streamways, coarse outwash and mountain slopes, but almost all of them are found in the vegetation of the plains in Sonora south of Lat. 30°. There the dominant plants are Olneya tesota, Cercidium torreyanum, Prosopis velutina and Encelia farinosa. On going south from central Sonora there is a steady increase in the number of common perennials and in the number of vegetative types that are represented. Cacti are locally abundant but often absent over large areas or found only as occasional large individuals.

287. Southern Pacific Co. MINERALS FOR INDUSTRY: SOUTHERN CALIFORNIA, SUMMARY OF GEOLOGICAL SURVEY OF 1955-1961 Vol. 3
San Francisco, Southern Pacific Co., Land Dept., 65 Market St. 242 pp., incl. illus., tables, ref. 1964
DLC TN23.9.S6

Divided into three parts: San Joaquin Valley, by W.H. Spurck; Western Mojave Desert, by W.H. Spurck; and Eastern Mojave and Colorado Deserts, by W.A. Oesterlir, and others. Each section includes maps, geology and mineral resources and commodity information. Commodity info. is presented in condensed form under 4 major headings, (1) Metallics -- potential sources of metals; (2) Industrial rocks and minerals, (3) Water resources, and (4) Geothermal resources -- useful sites for the production of natural steam, hot water and valuable minerals in brine.

288. Quezel, Pierre THE VEGETATION OF THE SAHARA BETWEEN TCHAD AND MAURITANIA (La vegetation du Sahara, du Tchad a la Mauritanie) Text in French. Stuttgart, Gustav Fischer, 1965
333 pp., incl. illus., diagrams, tables, 154 ref.
DLC QK409.Q4

The writer gives a complete abstract of the vegetation of the western and central Sahara between the Atlantic and the Sudan in monographic terms. He characterizes at first the history of botanic exploration in the region, and mentions in great outline the geological, geomorphological and climatic conditions. Then follows a flora-geographical classification of Africa and a vegetation-geographical division of the area of investigation, whereby the development since the Tertiary is followed. The vegetation of sand and salt soils, as well as wadis and for the other parts of the region, including the mountains, are differentiated and discussed. The Sahara is in no way confirmed as a bio-geographical barrier, but rather as a battle zone, into which plants came from north and south during the Quaternary.

289. Pahn, Perry H. SHEETFLOODS, STREAMFLOODS AND THE FORMATION OF PEDIMENTS Assoc. Amer. Geographers, ann., v.57, no.3 pp. 593-604, incl. illus., tables, 16 ref., 1967 DLC G3.A7

Field observations of four floods in the desert plains of southwestern Arizona indicate that such floods have the following characteristics: (1) floods near or on pediments exhibit supercritical flow -- this contradicts King's observations on turbulent and laminar flow causing pediments and invalidates Schultz's hypotheses for the origin of nickpoints; (2) floods on pediments occur as streamfloods with sheetfloods limited to the bahadas and this is verified by the local topography.

290. Sabins, Floyd E., Jr. INFRARED IMAGERY AND GEOLOGIC ASPECTS Photogram. eng., v.33, no.7 pp. 743-50, incl., illus., table, 6 ref. 1967 DLC TA593.A2P5

Structural and stratigraphic interpretations can be made from nighttime infrared scanner imagery in the Indio Hills, California. The younger, undeformed alluvium covering the valleys images distinctly cooler than the older, deformed sedimentary bedrock of the hills. The bedrock consists of two distinctly different stratigraphic-radiometric units. The poorly stratified unit has a distinct pattern of alternating warmer and cooler bands that correspond to outcrops of sandstone and siltstone beds respectively. A concealed trace of the San Andreas fault is revealed on the imagery by a cold anomaly apparently related to blockage of groundwater. Other faults and folds are imaged by offsets and strike changes in the patterns of the stratigraphic-radiometric units.

291. Mitchell, C.W. and R.M.S. Perrin THE SUBDIVISION OF HOT DESERTS OF THE WORLD INTO PHYSIOGRAPHIC UNITS In: International symposium of photo-interpretation, 2d, Paris, Sept. 26-30 1966, Papers in group VI.1, "Earth Sciences" Rev. inst. franc. petrole, v.21, no.12 pp. 1855-72, incl. illus., maps, 10 ref. Dec. 1966 DLC TP690.A1P322

A study of published literature and aerial photographs followed by a field study in the U.S.A. enable the surface of the world's hot deserts to be subdivided into physiographic units at 2 scales of mapping: 1:1,000,000 and 1:100,000. 39 recurrent larger units called 'land systems' can be defined to cover all known types of terrain at the smaller scale. 71 fairly homogeneous smaller units called 'facets' are adequate to cover most areas at the larger scale, though a separate unit, provisionally called a 'clump' is required for some areas of intricately varied internal meso-relief. Brief definitions of all land systems and facets are given in the appendix.

292. Morris, Thomas R. PRECIPITATION IN ARIZONA CUMULUS AS A FUNCTION OF CLOUD SIZE AND TEMPERATURE Jour. meteorol., v.14, no.3 pp. 281-83, June 1957, 4 ref. DLC QC851.A283

Near Tucson, Arizona, 80 clouds were observed with airborne radar and tops measured or estimated. Histograms are given of height of top, depth and cloud-top temperature on occasions of precipitation. The larger the cloud, the greater the probability of precipitation. There is a great increase of precipitation ratio above cloud top height 26,000 ft., cloud depth 14,000 ft.

293. Moyle, W.R., Jr. WATER WELLS AND SPRINGS IN BRISTOL, BROADWELL, CADIZ, DANBY AND LAVIC VALLEYS AND VICINITY, SAN BERNARDINO AND RIVERSIDE SOUNTIES, CALIFORNIA Calif. Dept. Water Resources bull. 91-14, 63 pp., incl. illus., tables 1967 DLC TD224,C3A53

By the US Geological Survey as a phase of the cooperative investigation of water wells and general hydrologic conditions in the desert region of southern California. The valleys described have an area of about 2,600 sq. mi; the area is one of interior drainage with no perennial streams. Broad alluvial fans extend into the basin from the mountains, and alluvium contains most of the ground water, received as runoff from the hills and mountains. Consolidated rocks consist of the basement complex, Tertiary volcanic and sedimentary rocks, and Quaternary basalt. The lower parts of the valleys are occupied by playa lakes, usually dry. Some wells produce commercial brines. Descriptions of wells and springs, water level records, chemical analyses, drillers' logs, a cross-index of published logs, and four reconnaissance geologic maps with well locations are included.

294. Mulcahy, M.J. LANDSCAPES, LATERITIES AND SOILS IN SOUTHWESTERN AUSTRALIA In: J.N. Jennings and J.A. Mabbutt (eds.), Landform studies from Australia and New Guinea. Canberra, Australian National University Press, 1967, incl. illus., 36 ref. DLC GB381.J4

A parallel series of zones is recognised parallel to the coast. Inland are salt lakes and sand plains. Then a zone of younger laterities -- the boundary between the two being called the Meckering Line. Within this zone is a small laterite-free zone. Coastwards is a zone of detrital laterites and then between the Darling scarp and the coast is the Coastal Plain. The sandplains were originally thought to be the fossil soils in situ but are now regarded as the result of weathering and colluvial transportation of laterite. Weathering is as deep under the broad valleys as under the sandplains of the divides and so the valleys are regarded as still being infilled and the peneplain is still being levelled. Extensive preservation of ancient soils is not common. Dating of soils or landsurfaces presents many problems. The younger laterites may be early Pleistocene.

295. Nir, Y SOME OBSERVATIONS ON THE MORPHOLOGY OF THE DEAD SEA WADIS Isreal jour. earth-sci., v.16, no.2 pp. 97-103 incl. illus., 4 ref., 1967 DLC QE318.A3

Describes deltas formed at the mouths of wadis at the Lisan Sea level and the present level of the Dead Sea. In many cases diversions have occurred, often through the delta deposits acting as a dam.

296. Nye, Thomas GEOLOGY OF THE PAYMASTER MINE, PIMA COUNTY, ARIZONA
Ariz. geol. soc. dig., v.4 pp. 161-168, incl. maps, 4 ref.,
Nov. 1961 DLC, unbound

The Paymaster mine is situated naer the northwestern margin of the Pima mining district and on the eastern pediment of the Sierrita Mountains, approximately 30 miles south-southwest of Tucson. The Paymaster area is essentially flat, with relief generally less than 10 feet, and is characterized by low rises and rounded hills of andesite surrounded, in an island-and-sea pattern, by granitic alluvium washed down from higher elevations to the west. The present discussion is a brief summary of the igneous rocks, their structure and alteration, and the ore deposits.

297. Ojany, Francis F. THE INSELBERGS OF EASTERN KENYA WITH SPECIAL
REFERENCE TO THE UKAMBANI AREA Zeit. geomorph., v.13,
no.2 pp. 197-206, incl. illus., ref., June 1969
DLC G1.247

The inselbergs in East Africa are mainly found in arid and semi arid parts of the country. Includes a brief survey on the early work on the inselbergs of Kenya, a note on their present day occurrence in Kenya, a suggestion on the mode of development of inselbergs as seen from those studied in Kenya and a brief statement intended to solve the main controversies that cloud appreciation of the processes at work in the formation of inselbergs.

298. Ordóñez, E. PRINCIPAL PHYSIOGRAPHIC PROVINCES OF MEXICO
Amer. assoc. petrol. geologists bull., v.20 pp. 1277-1307
1936 DLC TN860.A3

Using in general what has been published in the geologic and mining literature on the country, and supplemented with personal observations. The following provinces are of interest.

1. Lower California
 - a. Ensenada Sub-Province
 - b. Colorado Delta
 - c. Peninsular Sub-Province
 - d. Cape Region
2. Sonora Desert
3. Coastal Strip of Sinaloa and Nayarit
4. Western Sierra Madre
5. Eastern Sierra Madre
6. Central Plateau (Mesa Central Mexicano)
 - a. North-Central Plateau
 - b. South-Central Plateau

1.b Colorado Delta province is limited on the west by a long high mountain range, Sierra de los Cucupahs. The delta flood-plain is limited on the east by a row of low sandstone mesas at the foot of which the main stream usually passes. Central area is dominated by a large playa, the Laguna Salada.

2. Sonora: This area is characterised by one of extreme flatlands interrupted by deeply eroded, short, and low sierras with surrounding terraces and pediments. Mountains are not very high except in the eastern part where this sub-province forms the Western Sierra Madre of Mexico. The valleys of Altar and Hermosille Rivers are about the only green lands found. The low mountains consist of volcanic and intrusive rocks as well as a few areas of sedimentary rocks.

3. Coastal strip is simply a southward continuation of the sandy dry plain of Sonora Desert. It extends for nearly 500 miles along the water of the Pacific and between the foothills of the Western Sierra Madre Mountains and the ocean.

299. Penfound, W.T. A PHYSIOGNOMIC CLASSIFICATION OF VEGETATION IN
CONTERMINOUS UNITED STATES Botan. rev., v.33, no.3
pp. 289-326, incl. map, 1967 DLC QK1.B335

The designations of the physiognomic types were formed merely by adding the suffix-land to the life-forms of the dominant plants: forest (treeland, if desired), shrubland, grassland, savanna, tundra, vineland, forbland, herbland, and bryoland. The 3 major physiognomic types are forests, shrublands, and grasslands (201 communities). Shrublands comprise the scrubs and deserts of other investigators as well as many frutescent entities not previously designated as shrublands. Grasslands include both prairies and steppes as well as hydric communities such as wet meadows, grassy bogs, and marshes.

300. Miller, William J. CRYSTALLINE ROCKS OF SOUTHERN CALIFORNIA
Geol. Soc. Amer., bull., v.57 pp. 457-542, incl. illus.,
tables, map, May 1946 DLC QE1.G2

The crystalline rocks which occupy most of the 40,000 sq. mi. of southern California range in age from Early pre-Cambrian to Quaternary. They include metasediments, plutonics, migmatites, complexes, volcanics, metovolcanics, and dikes. Principal attention is given to the kinds, ages, origin, emplacement, distribution and correlation of the widespread crystalline rocks. Thirty large areas, representing all important parts of southern California, have been chosen for special study and description. A chart, representing a more or less preliminary correlation of the principal crystalline rock units of the 30 areas, accompanies the paper. Correlation problems are discussed at length. The occurrence of fossils in various metasedimentary formations has greatly aided in the aid determination of associated igneous rocks. Another chart shows 29 chemical analyses of carefully selected igneous rocks, and their calculated modes and norms. Petrographic descriptions of these rocks are given.

301. Merriam, Richard SOURCE OF PALM SPRINGS SEDIMENTS, IMPERIAL VALLEY, CALIFORNIA Amer. assoc, petrol. geologists, bull., v.49, no.10 pp. 1764-1765, 1965 (Abstract only)
DLC TN860.A3

Sands of the Palm Spring Formation are similar to those of the Colorado delta and those deposited in Lake Mead. All are very well sorted, and have similar median diameters and mineral composition. Cretaceous Foraminifera (reworked) which are widespread in the Palm Spring occur in the delta sediments. Both groups of sediments contain important amounts of volcanic and carbonate rock fragments and potash feldspar whereas plagioclase, hornblende, and augite are minor. The source indicated by this assemblage is the Great Basin. It is probable that most of the formation is Pleistocene delta sediment. (From a paper presented at the Pacific Section Meeting, American Association of Petroleum Geologists, April 9-10, 1964, Los Angeles, California.

302. McDonald, James E. VARIABILITY FACTORS IN MOUNTAIN-WATERSHED HYDROMETEOROLOGY IN AN ARID REGION Ariz. Acad. Sci., jour., v.1, no.3 pp. 89-98, 7 ref. July 1960 DLC PRR

The specific example chosen to illustrate the factors connected with the hydrometeorology in an arid region is that of the mountain watersheds of Arizona's Mogollon River area. First, a number of purely descriptive data which display some important hydrometeorological characteristics of several Arizona watersheds are given. Variability of precipitation and runoff is reported, tabulated and graphically represented. Finally, attention is drawn to several simple statistical arguments bearing on important problems associated with watershed modification.

303. Mayhew, W.W. ADAPTATIONS OF THE AMPHIBIAN SCAPHIOPUS COUCHI, TO DESERT CONDITIONS Amer. midlands naturalist, v.74, no.1 pp. 95-109, 1965 DLC QH1.A35

Spade-foot toads (Scaphiopus couchi), have been discovered recently in the Colorado Desert of California (Sonoran Desert), a region averaging approximately 2½ inches of rainfall per year and having very high summer temperatures (to 50°C). This is one of the driest and hottest areas in North America. The species was apparently more widely distributed along the California side of the Colorado River in an earlier pluvial period.

304. Long, Joseph T. and Robert P. Sharp BARCHAN-DUNE MOVEMENT IN
IMPERIAL VALLEY, CALIFORNIA Geol. soc. amer., bull., v.75,
no.2 pp. 149-56, incl. illus., tables, Feb. 1964, 7 ref.
DLC QE1.G2

The movement of 47 barchan dunes on the W side of Salton Sea, California, ranged from 325-925 feet over the 7 years between 1956-1963, an average of 82 ft/yr. During the 15 years between 1941-1956, the movement of 34 of these dunes ranged 350-1200 feet, an average of 50 ft/yr. This difference in average movement during the 2 intervals is attributed primarily to increased sand supply. Movement (D) plotted against height of slip face (H) for the Salton dunes fits reasonably well with Finkel's reciprocal curve ($1/D = n + kH$) or with a law of the type $D = Pe^{rH}$. Factors other than height affect the rate of movement, one of the more important being the state of the dune, whether growing or steady state. Barchan shape, whether fat or slim, may also influence the rate of movement of growing dunes. None of these dunes needs be more than 300 years old.

305. Edwards, E.I. THE ENDURING DESERT: A DESCRIPTIVE BIBLIOGRAPHY Los Angeles, Ward Ritchie Press, 1969, 316 pp.
\$27.50 DLC Z1251.S8E32

In his latest book, the author devotes most of his entries of books and magazine articles to Southern California deserts. Items are arranged by author with a checklist of books with incidental reference to California deserts, a partial record of journals, diaries, etc., and an author title index.

306. Dresch, Jean OBSERVATIONS ON THE ARID REGIONS OF SOUTH AMERICA AND THE UNITED STATES -- AN ATTEMPT AT COMPARISON (Observaciones sobre las regiones aridas de America del Sur y de los Estados Unidos -- Ensayo de comparacion.) Text in Spanish In: International Geographical Union, Latin American Regional Conference, Mexico, 1965, Proceedings, v.3 Mexico, D.F., Soc. Mexicana geogr. y estadistica, 1966, pp. 190-99 DLC G2.I5

The distribution of arid regions in the US is compared with those of South America, particularly those near the western border of both continents. Differences in elevation of ranges are noted with relation to latitudes and climates, glacier cover, and pediment character. Their evolution is discussed as affected by paleoclimatic changes of the Quaternary Period, as well as glacial, interglacial, and post-glacial tectonic activity, erosion and deposition.

307. Dresch, Jean QUESTIONS OF GEOMORPHOLOGY IN ISREAL (Questions de geomorphologie en Isreal.) Text in French Assoc. geogr. Franc., bull., no.350-351 pp. 2-14, maps, 1967 Also Ibid, no. 362-363, pp. 167-80, 1968, 47 ref. DLC

Present day Isreal presents two contrasting geomorphological features. In the Galilee highland with an elevation of 1000 m or more and a humid climate with a rainfall of 600-700 mm a year, there has been slope erosion of marls and limestones which overlies limestones. The arid Negev has a precipitation of less than 200 mm at Be'er Sheva and 30 mm at Eilat, as it is characterized by plateaus with faulting and asymmetrical folding of Paleozoic rocks. Abrupt transitions in climate are evident between the humid Mediterranean slope area and that of the arid Jordan graben.

308. Dresch, Jean RECONNAISSANCE STUDIES IN THE LUT AREA OF IRAN Reconnaissance dans le Lut (Iran). Assoc. geogr. Franc., bull., no. 362-363 pp. 143-53, incl. illus., 1968 DLC

Lut, the empty country, is formed by a number of enclosed basins in SE Iran. French and Iranian researchers are cooperating in this arid region. A brief geomorphological report distinguishes: coalescing piedmont debris cones, sand ridges (kalut), yardangs and fragmented plains. Variations in the kalut form are described in detail and are mapped from air photographs at a regional scale. The roles of tectonic and climatic changes are discussed in attempting their interpretation.

309. Coque, R. and A. Jauzain THE GEOMORPHOLOGY AND QUATERNARY GEOLOGY OF TUNISIA In: Guidebook to the geology and history of Tunisia Libya, Petroleum Exploration Society, 1967, pp. 227-58, incl. illus., geomorph. map, 17 ref. DLC

Tunisia is divided into four morphostructural provinces: (1) northern mountain belt or Tunisian Tell; (2) central mountain area or Dorsale, and the High Steppe; (3) southern Pre-Sahara; (4) eastern plains of low steppes, and the cultivated coastal lowlands, or Sahel. Most of the major topographical features are structurally controlled, many reflect Tertiary and Quaternary tectonism. Most of the piedmonts consists of a complex set of erosion surfaces or stepped glacis, with slope gradients decreasing from oldest to youngest. Near Tunisia five post-Villafranchian slopes can be discerned; this number decreases systematically southward. The stepped glacis are erosional surfaces cutting folded sediment and covered by less than 10 m of Quaternary fan material (locally of periglacial origin). In the southern Hamada the relief is composed principally of pediments which merge downstream into terraces formed above valleys which are covered by a calcareous crust dated Villafranchian. The stepped glacis have been morphoclimatically interpreted by the authors. Eustatic and tectonic explanations are rejected. They were formed during moister climatic periods, and dissected in drier periods. Sebkhass (salt lake beds) result from wind erosion of tectonic or sedimentary depressions during arid summers. Erosion is favoured by alternate wetting and drying of solontchak soils. Sebkhass are associated with dune-like ridge systems at their margins; most such systems date from the climatic optimum (maximum aridity?) at 6000 years B.P. A special aspect of the Tunisian scene is the combined effect of intense Quaternary tectonism and the rapid ascendance of arid conditions since the Villafranchian.

310. Wilson, L.G. and K.J. de Cook FIELD OBSERVATIONS ON CHANGES
IN THE SUBSURFACE WATER REGIME DURING INFLUENT SEEPAGE
IN THE SANTA CRUZ RIVER Water resources res., v.4, no.6
pp. 1219-34, incl. illus., 1968 DLC GB651.W32

Field studies were conducted during the winter 1965-1966 at an instrumented research site near Tucson, Arizona, to characterize changes in the sub-surface water regime of the stratified sediments at the site during influent seepage in the Santa Cruz River. At the peak of recharge from the principal runoff event of the winter, observation well data accounted for 33 percent of the observed total change in the subsurface water content. The remaining 67%, observed by means of moisture logs in access tubes, was contained in two near-saturated mounds in the intermediate vadose zone. Slow drainage of water from these mounds into the semiconfined phreatic zone apparently reduced the rates of recession of observation well hydrographs. Water content changes in the intermediate vadose zone and related long-term drainage should be accounted for during water balance studies and aquifer testing in the Tucson Basin.

311. Shear, James A. A SET-THEORETICAL VIEW OF KOPPEN DRY CLIMATES
Assoc. Amer. Geographers, ann., v.56, no.3 pp. 508-15,
incl. tables, graphs, 1966 DLC G3.A7

Using basic set theory, all climatic classes and sub-classes are seen as sets. Thus the Koppen primary classes A, C, and D are mutually exclusive thermal classes but may intersect the dry B sets. The subsets so formed, such as BSCsa provided much more meaningful nomenclature than BSh or BSk. The proposed view and resultant terminology (1) leaves the dry climates within the thermal framework already established, (2) simplifies the total system, (3) provides a more refined temperature description of the dry climates, (4) reveals more of climatic controls and location. BSCsa is easily seen as a steep climate, mesothermal, and on the dry side of a Mediterranean climate. The western half of North Africa is used to illustrate the effectiveness of the scheme.

312. Dresnay, R. du THE GEOMORPHOLOGY OF THE MOROCCAN HIGH ATLAS
(La geomorphologie du Haut Atlas oriental (Maroc)). Quater-
naria, v.8 pp. 155-65, 1966, 15 ref. DLC GN700.Q3

The High Atlas is one of four mountain ranges; the Rif, the Middle Atlas, the High Atlas and the Anti-Atlas, which stretch through Morocco from north to south. The High Atlas contains a broad saddle-back at about latitude 31°N. This large internal catchment area reveals a Paleozoic basement rimmed by a mantle of folded or tabular Jurassic sediments. The central zone of this area is flat, covered by fine and loamy deposits and pitted by numerous small closed depressions. A narrow outlet to the Sahara drains the area. In its morphological features, drainage system, desert climate, and still-active tectonic phenomena this area resembles internal basin-plains in desert zones of the North American mountain ranges.

313. Downs, Theodore, and John A. White A VERTEBRATE FAUNAL SUC-
CESSION IN SUPERPOSED SEDIMENTS FROM LATE PLIOCENE TO
MIDDLE PLEISTOCENE IN CALIFORNIA Internatl. Geol. Cong.
23rd, Prague, 1968, Proc. Sect. 10, pp. 41-47, incl. illus.,
1968 DLC QE1.I6 1968

Mammalian, avian, and retilian taxa (over 90) have been recovered in one continuous sequence of strata in a portino of the western Colorado Desert of Southern California. The stage of evolution and total known geochronologic range of many of the taxa indicate Late Pliocene to Middle Pleistocene time for the period of deposition of over 8,000 feet of the section. Within the upper 8,000 feet there are rodent and rabbit taxa with well documented "local range zones," some of which overlap. This uninterrupted sequence of faunas or record of "range zones" of taxa and the continuous gradational deposition of sediments in this area reveal no obvious time-stratigraphic or rock-stratigraphic "boundaries," including one between the Tertiary and Quaternary.

314. DiCesare, F. and W. Pratelli 'MOVING STONES' OF THE TUNISIAN SAHARA (BIR PISTOR) In: Guidebook to the geology and history of Tunisia Libya, Petroleum Exploration Society, 1967 pp. 273-76, incl. illus., ref. DLC

Trails associated with 'moving stones' have been observed in southern Tunisia. The trails are 10-142 m long, have been formed by siliceous limestone pebbles and boulders, and cross a flat plateau surface, locally going perpendicular to streambeds. In the US similar phenomena (e.g. playa scrapers) are explained as occurring by slippage on frozen or muddy surfaces under the action of strong winds. Soil and climatic conditions in Tunisia differ from western US and this explanation is rejected for these trails. A tentative hypothesis is that movement occurred because of swelling of the underlying mixture of gypsum and clay caused by above average condensation on one side of the bigger boulders.

315. Des Jardins, Robert B. THE DISTRIBUTION OF CLOUDS AT TUCSON ARIZONA, WITH RESPECT TO TYPE, AMOUNT, AND TIME OF OBSERVATION Arizona Univ. Inst. Atmos. Phys., Sci. rept. no.6 Jan. 1, 1958 52 pp. DWB

Cloud data for Tucson, Arizona for July 1945-1954 are analyzed statistically in every conceivable manner and presented, with ample discussion, in tables and graphs. The discrepancies in the data are mentioned and their causes (changes in cloud reporting procedure, climatic variations, etc.) are analyzed with suggestions for homogenizing the data presented for low, middle and high clouds, respectively. The diurnal, annual and year to year variations of clouds at Tucson are also treated in detail, both as to the frequency of convective and stratocumulus clouds, and middle and high clouds. Lastly the relation between cloud amount and precipitation is discussed and illustrated with graphs.

316. Dawson, E.Y. THE CACTI OF CALIFORNIA Berkeley, University of California Press, 1966, 64 pp. (Calif. Nat. Hist. Guides No. 18) QK495.C11D25

The cacti of California provide an interesting and comprehensive assortment of members of this unique plant family. There is a section on cactus books and clubs, a glossary and an index to genera, species, and names.

317. Cruff, R.W. and T.H. Thompson COMPARISON OF METHODS OF ESTIMATING POTENTIAL EVAPOTRANSPIRATION FROM CLIMATOLOGICAL DATA IN ARID AND SUB-HUMID CLIMATES US Geol. Survey, Water-supply paper no. 1839-M, 28 pp., 1967, ref. DLC TC801.U2

This study compared potential evapotranspiration, computed from climatological data by each of 6 empirical methods, with pan evaporation adjusted to equivalent lake evaporation by regional coefficients. The 6 methods tested were the Thornthwaite, US Weather Bureau (a modification of the Penman method), Lowry-Johnson, Blaney-Criddle, Lane, and Hamon methods. The test was limited to 25 sites in the arid and sub-humid parts of Arizona, California, and Nevada, where pan evaporation and concurrent climatological data were available. However, some of the sites lacked complete climatological data for the application of all 6 methods. Average values of adjusted pan evaporation and computed potential evapotranspiration were compared for two periods -- the calendar year and the 6-mo. period from May 1 thru October 31. The 25 sites sampled a wide range of climatic conditions. Ten sites (group 1) were in a highly arid environment and 4 (group 2) were in an arid environment that was modified by extensive irrigation. The remaining 11 sites (group 3) were in a subhumid environment.

318. Davis, George E. and Joseph L. McCarthy TWENTY-FIVE MONTHS OF SOLAR RADIATION AT TUCSON, ARIZONA Monthly weather rev., v.60, no.12 pp. 237-42, Dec. 1932 DLC QC983.A2

Intensities of direct solar radiation at wave lengths 0.50u and 0.32u were measured at Tucson, Arizona, from Feb. 1930 to Jan. 1932. The records were traced automatically on photographic plates by a Pettit solar radiometer. From the measurements on 500 plates, the authors computed values of intensity of radiation in absolute units for 9h, 12h, and 15h local apparent time. The data on intensity of solar radiation are presented by graphs in which each plotted point is an average of 10 daily values. Graphs showing average values of solar radiation of wave lengths 0.50 and 0.32u from the above curves are given.

319. Symmons, P.M. and C.F. Hemming A NOTE ON WIND-STABLE STONE
MANTLES IN THE SOUTHERN SAHARA Geograph. jour., v.134,
no.1 pp. 60-64, incl. photos, tables, 4 ref. March 1968
DLC G7.R91

In deserts large areas are covered by a mantle of stones of varying sizes assumed to result from wind action removing the smaller particles of the matrix in which the stones were set. At present these surfaces are stable to wind erosion. Sand can be stored in the mantle and moved across it. It is claimed that such a surface could be produced by wind erosion, and that the depth of mixed stony soil from which the finer material must have been removed can be calculated. Analytical procedure and the characteristics of four experimental plots are described. Measurements showed that finer material not protected by the overlying stone mantle was removed by the wind, and that deflation had lowered the surfaces by differing amounts. Little rain water was absorbed by the soil, but some sheet flow is to be expected. Almost certainly the surface studied is wind-stable and without the present stone-mantle deflation would occur. The stones appear to have been transported over a considerable distance; as the deposit is not ordinary alluvial gravel it could have been produced under more humid conditions of the past at the foot of the mountains bordering the Tamesna plain before flowing over it as a kind of stone-mud mass in which the stones remained suspended. The **restricted size range of stones implies some sorting near the mountains.** Probably there were stone-mud flows containing different-sized stones flowing together, mixing to some extent, but never fully losing their identity.

320. Scholz, C.H. and Thomas J. Fitch STRAIN ACCUMULATION ALONG THE SAN ANDREAS FAULT Jour. geophys. res., v.74, no.7 pp. 6649-66, incl. table, graphs, 51 ref., Dec. 15, 1969 DLC QC811.J6

The patterns and rates at which strain is accumulating along the San Andreas fault in California are analyzed from geodetic data. Geodimeter and triangulation data indicate displacements near the fault that are a result of homogeneous strain to an approximation within the accuracy of the data. Both sets of data indicate that nearly pure shear with a maximum shear plane nearly parallel to the fault is accumulating at a rate of about $0.7 \times 10^{-6} \text{ yr}^{-1}$ from San Francisco Bay to the Transverse Ranges. The nearly east-west trending segment of the fault in the Transverse Ranges is accumulating nearly uniaxial compression normal to the fault at a rate of $1.1 \times 10^{-6} \text{ yr}^{-1}$, indicating a 'locking' mechanism. At no point, with the possible exception of the Cholame Valley, do fault creep and small earthquakes substantially release the accumulating strain. A more complete set of data in the Imperial Valley suggests that the strains accumulating there are such as would be released by fault slippage at a rate of 8.5 cm yr^{-1} , and earthquakes occur only to a depth of approximately 10 km. Strains at greater depths must be relieved by aseismic slip or inelastic deformation.

321. Sharp, Robert P. GEOMORPHOLOGY OF CIMA DOME, MOJAVE DESERT, CALIFORNIA Geol. Soc. Amer., bull., v.68 pp. 273-90 incl. illus., maps, ref., March 1957 DLC QE1.G2

Cima Dome, a remarkably smooth symmetrical alluvium-fringed rock dome in the desert of southeastern California, is the prototype of Davis' granitic desert dome, supposedly convex and presumably developed by the backwearing of a granitic fault block. Transit-stadia profiles across Cima Dome show concave or essentially straight slopes and demonstrate that it is not convex except to a slight degree in the uppermost 25 feet. Geophysical exploration by resistivity, gravity, and seismic methods on the southeastern flank reveal no boundary fault or any form unequivocally identifiable as the convex suballuvial bench deduced by Lawson. At its deepest point the granitic rock floor is buried by 1300 ft. of overburden composed of 550 feet of alluvium, or geophysically comparable material, and 650 feet of more coherent rock, presumably welded rhyolitic tuff. Cima Dome is primarily a regarded part of an extensive late Pliocene-early

Pleistocene erosion surface, Hewett's Ivanpah upland, now buried by Pleistocene volcanic rocks immediately to the west. The dome may be an erosion residual on that surface or it may have been created largely by subsequent deformation, primarily warping. Evidence cited favors the warping hypothesis. The present profile of Cima Dome is due to erosion and regrading in the current cycle, and in most places the smoothness of slope and the symmetry are due to uniform debris yielded by granular disintegration of homogeneous quartz monzonite composing the dome. The relations at Cima Dome and elsewhere suggest that the role of recent warping merits consideration with regard to the origin of closed basins, broad divides, disintegrated drainages, areas of dissection and related landscape features in the desert of southeastern California.

322. Shreve, Ronald L. THE BLACKHAWK LANDSLIDE Geol. Soc. Amer., Spec. Paper 108, 47 pp., incl. illus., map, table, 41 ref. 1968 Price \$3.75 DLC QE599.U535

Blackhawk Mountain in southern California rises above southeastern Lucerne Valley at the eastern end of the rugged 4,000 foot escarpment that separates the San Bernardino Mountains on the south from the Mojave Desert on the north. Its summit is a resistant block of marble thrust northward over easily eroded uncemented sandstone and weathered gneiss. Spread out on the alluvial apron at the foot of the mountain is the **prehistoric Blackhawk landslide**, a lobe of nearly nonolithologic marble breccia from 30 to 100 feet thick, 2 miles wide, and 5 miles long. The Blackhawk landslide and an adjacent older landslide, the Silver Reef, have many peculiarities of form and structure in common with the historic Elm, Frank, and Sherman landslides; and in lithology, provenance, size, and 'coefficient of friction' they strongly resemble many of the monolithologic breccia deposits of possible landslide origin found associated with Tertiary faults and fanglomerates in the southwestern United States and elsewhere. Both the geological evidence and, in the case of the Elm and Frank landslide and its congeners started as huge rockfalls, which were launched into the air and then traversed the gently inclined, relatively smooth slopes below as nearly nondeforming sheets of breccia sliding at high speed on a relatively thin, easily sheared lubricating layer.

323. Steenbergh, Warren F., and Charles H. Lowe CRITICAL FACTORS
DURING THE FIRST YEARS OF LIFE OF THE SAGUARO (CEREUS GIGANTEUS)
AT SAGUARO NATIONAL MONUMENT, ARIZONA Ecology, 50, no.5
pp. 825-34, incl. illus., tables, ref. 1969 DLC QH540.E3

Germination and establishment of the saguaro giant cactus were studied by periodic observations on natural seedling populations, seedling distribution within rocky, rolling hill, and flat terrain habitats, and field-germination experiments in the Sonoran Desert. As a result of bird, mammal, and insect activity, a very small percentage of seeds (1×10^{-3} of the seed crop) remains on the ground until suitable conditions for germination occur during the summer monsoon. Germination begins after the start of summer rains in July and continues in August and September. The principal apical stem growth of seedlings takes place during these months, with a few plants exhibiting slight growth during favorable late winter and early spring months. Establishment of seedlings is limited primarily by frost, drought, rodents, and insects, which affect the differential survival associated with seedling size, microhabitat, and season. Initial high rates of seedling mortality drop sharply after the first year and are lowest for plants associated with micro-environments among rock outcrops. The large number of seeds germinated in the alluvial soils of the flat terrain habitats is offset by a higher seedling mortality there. In the rocky habitats more seedlings survive from fewer germinations. The significant difference is attributed primarily to the effect of the microhabitat upon the operation of the critical controlling factors listed above.

324. Reed, Charles A. A NATURAL HISTORY STUDY OF KURKUR OASIS,
LIBYAN DESERT, WESTERN GOVERNATE, EGYPT Postilla, 84,
1964 20 pp., 22 ref. DLC PRR

In response to a request by the UAR to salvage the monuments of Nubia, the Yale Prehistoric Expedition was undertaken in March 1963. Emphasis was placed on the study of past environments. An oasis, the Kurkur Oasis, was chosen because this type of environment has been least effected by the flow of the Nile River. Representing local climatic conditions, an oasis is most sensitive to climatic changes. This oasis lies in an area of Cretaceous to Eocene marine sediments and was apparently formed where a wadi was eroded from a platform through a scarp onto a plain. The origin of the water in Kurkur Oasis is discussed. Possibilities presented are: (1) local rainfall held by an impervious layer at the bottom of the oasis, (2) the presence of a high water table, and (3) springs lying on top of a fault line, the water rising from a deeper source than the local water table. Any conclusions determining the origin of the water must be derived at in terms of the tufa deposited by springs in the geologic past. Periods of deposition alternated with periods of diminished water supply. The alternations may possibly be correlated with local changes in water supply or with world-wide climatic changes during the Quaternary Period. The oasis is not now inhabited although artifacts of early man have been found. A history of exploration and scientific research at the Kurkur Oasis is presented.

325. Twidale, C.R. HILLSLOPES AND PEDIMENTS IN THE FLINDERS RANGES, SOUTH AUSTRALIA In: J.N. Jennings and J.A. Mabbutt (eds) Landform studies from Australia and New Guinea. Canberra Australian National University Press, 1967 pp. 95-117, incl. illus., tables, 32 ref. DLC GB381.J4

Describes the landscape of the area and the present accelerated erosion by gullying and sheetwash following the activities of man. The structural control of hillslopes and processes of weathering and erosion on slopes are described. Most of the plains are of depositional origin. The present debris mantle is often coarse, is being transported slowly, and exercises a protective influence on the slopes. On the lowest angle slopes (below 30°) this coarse material must be immobile at present. A maximum for chemical weathering is inferred for fairly gentle slopes below retreating scarps. Rock pediments may have been cut by the planing action due to the movement of the overlying debris. At the top of the pediment is the piedmont angle and then the steeper scarp slope. This angle is located along the inferred zone of chemical weathering. Rather than parallel retreat, it is inferred that the angle has grown sharper with time.

326. Twidale, C.R. ORIGIN OF THE PIEDMONT ANGLE AS EVIDENCED IN SOUTH AUSTRALIA Jour. geol., v.75, no.4 pp. 393-411, incl. figs., 27 ref., 1967 DLC QE1.J8

The Piedmont angle of semi-arid and arid regions is commonly located by structure of lithology, and sometimes by faulting. Differential weathering and erosion are able however to produce a sharp piedmont angle even in the absence of geological factors. Piedmont sections show that the thin debris mantle thickens downslope, and that the intensity of weathering is very great immediately below the piedmont angle and decreases downslope until at about 1 km, the bedrock appears fresh. The intensely weathered zone is often extensively excavated by streams running along it. This stream erosion leads to the isolation of a sequence of pediment residuals from the mountain scarp, and maintains a steep scarp gradient and a steep piedmont angle. Examples which demonstrate these relations are taken from the Flinders Range and the Eyre Peninsula. Slowing down and percolation of runoff from the mountains on reaching the piedmont angle, and the geological relations at the piedmont angle are thought to explain the observed distribution of weathering. It is suggested that an initially gentle piedmont angle will be formed at the foot of a scarp by wash, rills and mass movement. Scarp-foot weathering and stream dissection are then able to produce the characteristic sharp piedmont angle which is necessarily associated with the separation of residual surfaces from the mountain scarp.

327. Warren, David H. A SEISMIC-REFRACTION SURVEY OF CRUSTAL STRUCTURE IN CENTRAL ARIZONA Geol. Soc. Amer., bull., v.80, no.2 pp. 257-82, incl. illus., tables, graphs, maps, 22 ref. Feb. 1969 DLC QE1.G2

The US Geological Survey conducted a seismic-refraction study of the earth's crust and upper mantle near the Tonto Forest Seismological Observatory, (TFO), located 10 miles south of the Mogollon Rim near Payson in Central Arizona. Two recording lines 400 km long intersect in the approximate form of a cross at TFO; one line trends southeast and the other northeast, originating at Sunrise and passing through Gila Bend in the Sonoran Desert. The sedimentary layer at most places southwest of the rim is less than 1 km thick, but north of the rim it is 2 to 3 km thick. The velocity in this uppermost layer ranges from 2.6 to 4.7 km/sec, with the higher limit measured near or north of the rim. Arrivals refracted in the upper crust (Pg) can be attributed to two layers for all the shot points south of the rim. The velocity in the upper layer is about 5.9 km/sec with thickness ranging from 2 to 8 km; beneath the upper layer the velocity is about 6.1 km/sec. The upper layer seems to be absent northeast of the rim, where two shot points generated P arrivals that show only a velocity of 6.2 km/sec. A Poisson ratio of 0.22 for the upper crustal layers was measured from shear and compressional arrivals. The lower crust could not be identified from the first and later refraction arrivals; however, minimum depths to the intermediate layer were determined. An average crustal velocity of 6.2 km/sec was measured from wide-angle reflection alignments. A thin intermediate layer would explain the seismic measurements.

328. Tuan, Yi-Fu PEDIMENTS IN SOUTHEASTERN ARIZONA Calif., Univ.,
Pubs. Geogr., v.13, 163 pp., incl. illus., tables, maps,
66 ref., 1959

"The pediment is the peidmont surface that cuts across the rock formations of the mountain ranges. It slopes away from the residual mountain and is commonly fringed by an alluvial apron or by a degradational surface developed on old alluvium." Lawson's and Johnson's hypotheses of pediment origin, also the concept of exhumation, are briefly examined. The purpose of this study was to test the relative merits of the various hypotheses on pediment formation by an intensive survey and mapping of a series of pediments in southeastern Arizona south of the Gila River, east of the Santa Cruz and Altar Valleys, and west of the Sulphur Spring Valley. In the second section of the paper the topography of this area and the structure of individual ranges and basins are described, then individual pediments of the Tucson, Sierrita, and Sacaton Mountains, Tortilla Mountains and Black Mountain, Tortolita, Santa Catalina, and Huachuca Mountains, Johnny Lyon Hills, Little Dragoon, and Dragoon Mountains. The third and final section of the paper consists of a synthesis dealing with types of pediment in southeastern Arizona, relations between environment and pediment, review and evaluation of major hypotheses on pediments and a synthesis of theories of origin: "There are 5 major types of pediments in southeastern Arizona: (1) the Huachuca type, (2) the Sacaton type, (3) the Tucson (volcanic) type, (4) the Northwest Dragoon type and (5) the Sierrita type. The origin of each type, their relation to one another, and their place in the degradational sequence need now be considered within the framework of a comprehensive theory. Evidence derived from observation of the pediments in southeastern Arizona supports a theory of exhumation that is closely akin to A.C. Lawson's deductive analysis of the development of the suballuvial bench."

329. Font Tullot, Inocencio CLIMATE OF THE SAHARA, WITH SPECIAL REFERENCES TO THE SPANISH ZONE (El Clima del Sahara, con especial referencia a la zone Espanola) Madrid, Congejo Superior de Investigaciones Cientificas, 1955, 112 pp., 11 ref.
DLC QC991.53F6

Part one contains a description of the physical geography of the Sahara and of the overall climate including a general survey of the individual meteorological variables, air masses, cyclonic disturbances, etc. Part 2 presents a detailed description of the climate of the Spanish zone, and in Part 3 the author discusses the water problems in the Sahara, climate and agriculture, the salubrity of the climate, wind and solar energy in the Sahara, and the encroachment of the desert as a result of human actions. Data are presented in graphs and isolines. Tables are given for Villa Bens, Villa Eisneros, and Sahara.

330. Fletcher, Joel, Karl Harris, H.b. Peterson and V.N. Chandler
PIPING Amer. Geophys. union, trans., v.35, no.2 pp. 258-263, incl. illus., table, April 1954, 6 ref. DLC QE500.A6

Investigations by the authors over a 6 year period indicated that piping is widespread in western United States and that it occurs in at least the following countries: New Zealand, Australia, China, South Africa and Turkey. While this type of erosion has been observed in upland areas of the US, the great concentrations are in alluvial bottom lands. Five conditions that must be present for that type of erosion known as piping are; (1) there must be a source of water, (2) surface infiltration rate must exceed permeability rate of some subsoil layer, (3) there must be an erodible layer just above the retarding layer, (4) water above the retarding layer must have a hydraulic gradient to make it flow, and (5) there must be an outlet for the lateral flow. These postulates were tested by detailed studies of the 5 principal piping areas of Arizona (including the Picacho area in the Sonoran Desert). It was found that all were present on each area.

331. Finkel, H.J. THE BARCHANS OF SOUTHERN PERU Jour. geol.,
v.67, no.6 pp. 614-47, incl. illus., maps, tables, graphs,
Nov. 1959, 39 ref. DLC QE1.J8

The crescentic sand dune formation known as the "barchan" occurs extensively in the desert coast of southern Peru. Quantitative measurements were made on 75 of these to determine relationships between height, width, and length of horns. A consistently longer west horn was measured in most of the barchans, but this distortion cannot be readily explained. Mechanical analyses of the dune sand were performed on samples taken from the Pampa de Clemesi and the principal barchan deposits in the Pampa de la Joya, as well as from deposits further downwind from La Joya. There is a consistent increase in the proportion of the fine material in the samples taken farther from the Pampa de Clemesi. The bulk specific gravity also decreases with distance from Clemesi. Bulk specific gravity varied with dune height. Mineralogical analyses of these same samples indicate a decrease in the heavier minerals with increasing distance from the Pampa de Clemesi, and an increase in the volcanic, fibrous glass. This evidence indicated that the La Joya barchans originated from the Pampa de Clemesi and extend over a strip 100 km downwind, unobstructed by the transversal river channels, which are from 600 to 800 m. deep.

332. Hastenrath, S.L. THE BARCHANS OF THE AREQUIPA REGION, SOUTHERN PERU Zeitschrift fur geomorphologie, v.11, no.3 pp. 301-331, incl. illus., 9 ref., 1967 DLC G1.Z47

Extremely well developed barchans on a level sandplain in a very dry climate and lacking any vegetation were subject to vertical photography in 1955 and 1958 and to ground surveying in 1964. Crest heights show a normal distribution about a 3-4m. mode (range 0.4 to 6.0 m). The higher the dune the more the windward slope departs from convexity to uniform slope; slipfaces were uniform at 32° . Linear regressions were calculated for increase of heights with horn width, increase in height with steepness of windward slope along the centreline, decrease of bulk specific gravity of dune sand downwind, increase downwind of the proportion of the 177-125 micron size in relation to the coarser fractions. There is also a reduction of magnetite content downwind. In another study area dune height first increased downwind and then decreased in the same direction. Bulk specific gravity varied inversely with dune height; larger dunes consist of finer material than small ones. Within individual dunes, bulk specific gravity increases from the windward toe to the horn tips and lowest values are found on the lower slipfaces. Magnetite content seems to have a similar pattern. Circulation within the barchan therefore is thought to consist of a movement of the heavier grains from the windward slope to slip down the rear face, with intermediate streamlines between. This pattern conserves an aerodynamic equilibrium which is, however, dependent on a supply of sand inhomogeneous in size and density. The steady state form is then maintained during bodily displacement. The displacements between 1955 and 1964 show smaller dunes moved more than larger ones. Movement was faster in the 1958-1964 period than in the 1955-1958 one and this is associated with a greater frequency of smaller, lower dunes in the later period. Windward slopes were also gentler in the second period, size for size. So decrease in size of dunes as well as increased frequency of strong winds is involved in the change of rate of displacement. In direction, displacement in the later period has a westerly component as well as a northerly major displacement. Increase in nocturnal katabatic winds may be responsible for this increased westerly component in the later period.

333. Grove, A.T. and A. Warren QUATERNARY LANDFORMS AND CLIMATE
ON THE SOUTH SIDE OF THE SAHARA Geogr. jour., v.134,
pt. 2 pp. 194-208, incl. illus., 50 ref. June 1968
DLC G7.R91

Former dunfields, soil formations, and old lake strand-lines and deposits demonstrate that desert limits shifted considerably both north and south during the later stages of the Quaternary. Recent investigations have employed carbon-14 dating to assist in producing a timescale, and it is possible to classify landforms according to four periods of development; (1) features formed in mid-Pleistocene or earlier times; (2) forms originated in major arid periods; (3) forms attributable to the last main pluvial; and (4) more recent events and landforms. Several regions are carefully described and their landforms evaluated in these terms. Included are Senegal and Mauritania, the Majabat al-Koubra and Aouker and the Chemchane Sebkha, the Middle Niger, the Chad Basin, the Sudanese Qoz, and the Nile Valley. Evidence examined suggests that the most conspicuous feature of the climate history on the south side of the Sahara in Late Quaternary times is the pluvial period from 10,000 to 7,000 B.P., which may have been made up of several phases. Arid periods of greater extent than the present probably preceded this, but since 7,000 B.P. the climate has fluctuated.

334. Gorsline, Donn S. ANNUAL SUMMARY REPORT OF GEOLOGICAL STUDIES
OF THE COLORADO DELTA Southern Calif., Univ., Dept.
Geol., Rept. 65-3, 1965 16 pp., incl. illus. DLC

Field studies to date (August 1965), have included: (1) reconnaissance trips to view the general lower delta area and to gain familiarity with access routes to all parts of the delta; (2) the establishment and monitoring of stations to determine the changes in gross tidal flat structures and topography; (3) photographing, measurement and mapping of small scale sediment features and structures and the associations of these with various parts of the shore and intertidal zones; and (4) sampling of surface sediments for later laboratory analyses of composition and texture. Preliminary analysis and interpretation indicate that the features of the tidal flats of the delta approach change with each tidal cycle and at a readily measureable rate. The features of the mud flats, tidal creek system and marshes are much less subject to short term changes. Salines and desiccated mud flats are the most common form of delta surface and include gypsum crystals in red muds, salt pans over red muds and polygonal salt crusts and mud cracked sur-

faces. Marshes are far less important on the Colorado Delta surface than on such deltas as the Mississippi. This reflects the arid climate of the region. There appears to be only minor subsidence of the delta sediment. This may be due in part to the relative unimportance of peaty deposits or to deformation by regional faulting which is of much larger consequence than compaction effects. The texture of the sediment and the rapid drying of newly sedimented surfaces may also be factors. The broad terrace that forms the Sonoran coastal plain in the vicinity of the delta may be an uplifted segment of older delta sediment. The cliffs bordering the eastern side of the lower delta may be a fault scarp. Springs are common along the foot of this cliff line. The larger western tidal distributary and its associated salina may be a surficial expression of a low structural dome in the southwestern lower delta.

335. Friedman, Don G. FROST SURVEY OF THE COACHELLA VALLEY IN SOUTHERN CALIFORNIA Travelers Weather Research Center, Hartford, Conn., Occasional papers in meteorol., No. 3, June 1959, 136 pp., 8 ref. DWB M(055)T779oc

One hazard to Coachella Valley crops is the occasional occurrence of damaging frost in the winter season. The purpose of this study was to assemble the available information which could be used to define the relative frost hazard in various sections of the valley. Inasmuch as "frost" damage can occur in the absence of ice crystals, air temperature was considered to be a better criterion for measuring the extent of plant injury than the occurrence or nonoccurrence of frost. Below freezing temperature records at all Coachella Valley stations were examined. Most of the records were five years or less in length. The temperature record at Indio, California was found to be the longest and most complete. Consequently, Indio was used as a "bench mark" station and the long-term characteristics of below-freezing temperature occurrence in the Coachella Valley were investigated using this 27 year record. Low-temperature occurrence at other Coachella Valley stations were then related to occurrences at the "bench mark" station during a five year period. On the basis of these relationships, the frost hazard in the various sections of the Coachella Valley were outlined. Both the minimum temperature and the duration that the temperature is below the critical temperature are important in determining the amount of frost damage to a particular crop. The critical temperature depends upon a number of other weather and nonweather factors. Consequently, a single critical temperature cannot be defined. For this reason, the minimum temperature and duration in hours below three possible critical temperatures were used in this study. These data for all Coachella Valley stations are tabulated in Appendixes A-F of this report.

336. Lacy, W.C. and Spencer R. Titley GEOLOGICAL DEVELOPMENTS
IN THE TWIN BUTTES DISTRICT Mining cong. jour., v.48,
no.4 pp. 62-64, 66, incl. illus., map, 8 ref. April
1962 DLC TN5.A7

The discovery of the Pima ore body, located south of Tucson, Arizona, by geophysical methods a decade ago set off increased activity in the Twin Buttes mining district. The application of improved geological geophysical, and geochemical techniques have continued to reveal major discoveries as "blind" ore bodies under the pediment cover and beneath leached capping. The lack of continuous outcrops and the complexity of faulting, volcanic, and intrusive activity have led to varied interpretations of geological relationships and history. The Twin Buttes district occurs within a stack of thrust sheets that fringe the eastern edge of a large Laramide granodiorite batholithic complex. The thrusting has involved rocks ranging in age from Precambrian to Tertiary. The mineral deposits are located adjacent to the batholith complex and are of 3 types: deposits in reactive host (e.g. limestone); deposits in nonreactive host (e.g. clastic sediments or volcanics); and fissure veins. The Pima, Mission, and Palo Verde ore bodies are found in a reactive host and the Esperanza deposit in a nonreactive host. Based on their interpretation of geologic relationships and history, the authors suggest that favorable zones for ore discovery would: tend to follow the margins of the batholith, tend to be concentrated where the batholith had been offset during the late magmatic stages, tend to be distributed along the flat-lying thrusts, and tend to be localized within chemically favorable beds.

337. Kunkel, Fred and F.S. Riley GEOLOGIC RECONNAISSANCE AND TEST-
WELL DRILLING, CAMP IRWIN, CALIFORNIA US Geol. Survey,
Water-supply paper 1460-F 39 pp., incl. map, May 1959
DLC

Covers 5 alluvial-filled structural basins herein called the Camp Irwin, Bicycle, Langford, Coyote, and Dry Gulch basins. These basins lie NE of the town of Barstow within or near the Camp Irwin Military Reservation. The geologic units are grouped in 2 categories: consolidated rocks and unconsolidated deposits. The consolidated rocks are mostly hard and impervious, and, except for minor amounts in cracks and fractures, they are generally not water bearing. The unconsolidated deposits are porous and generally not water bearing. The unconsolidated deposits are porous and generally more permeable, and as a group are potentially capable of storing, transmitting, and yielding significant

quantities of ground water. The consolidated rocks, as mapped, include the crystalline basement complex of pre-Tertiary age, a series of volcanic and associated continental sedimentary rocks of Tertiary age, and 2 groups of volcanic rocks of later Tertiary to early Quaternary age. The unconsolidated deposits, as mapped, comprise 6 units of alluvial deposits ranging in age from late Tertiary to Recent, as follows: granitic gravel of unknown origin, older fan deposits, older valley-floor alluvium, alluvial-fan deposits, valley-floor alluvium, and wash deposits. There are also 2 units of lake deposits, ranging in age from late Pleistocene to Recent, as follows: lacustrine and playa deposits, and dune sand of Recent age. Four test wells were drilled in connection with this study. The logs of materials penetrated, the summaries of test pumping, and the chemical analyses of the waters are included; also given are similar data for 7 wells drilled by the US Army from 1941 to 1944. The geologic reconnaissance and well data indicate that the valley-floor areas of Camp Irwin, Bicycle, Langford, and Coyote basins are favorable for the development of ground water. Wells in these 4 basins yield from 115 to 1,700 g.p.m. One well in Dry Gulch basin that was drilled to a depth of 335 ft. bottomed in basalt above the water table.

338. Biehler, Shawn, Robert L. Kovach and Clarence R. Allen
 GEOPHYSICAL FRAMEWORK OF NORTHERN END OF GULF OF CALIFORNIA STRUCTURAL PROVINCE In: Andel, Tjeerd H. van, and George G. Shor, Jr. (eds.), Marine geology of the Gulf of California: a symposium. Tulsa, Okla., American Association of Petroleum Geologists, Memoire 3, 1964. pp. 126-43, incl. illus., graphs, map, 35 ref. DLC QE39.A5

More than 3,000 gravity observations in the Northern Gulf province, including an underwater gravity survey of the Salton Sea, show the over-all trend of isogal contours to be northwest, parallel to the tectonic pattern dominated by the San Andreas fault system. Contours northeast of the trough trend east, probably reflecting Transverse Range structures in this area. A prominent and linear gradient of 5 mgal/km marks the Banning-Mission Creek fault in the Coachella Valley but dies out southeastward at about the same point the surface trace disappears. The San Jacinto fault zone is characterized by a series of maxima and minima that tend to confirm continuity of this fault zone to the Gulf of California. A 15-20 mgal maximum over the Obsidian

Buttes suggests a large anomalous mass at depth, or may be related to contemporaneous metamorphism of the Tertiary sedimentary section that has recently been observed in nearby stream wells. The regional gravity gradient indicates a crustal thickening northwest from the Gulf of California; inferred crustal thicknesses are 32 km at the International Border and 40 km at San Geronio Pass. Ten seismic refraction profiles in the Imperial and Coachella Valleys indicate several throughgoing velocity zones, but we are unable to correlate these with known stratigraphic units. The maximum thickness of sediments in the trough appears to be about 6.4 km (21,000 ft) just south of the International Border, with basement becoming shallower both to the north and south. The Salton trough and Gulf of California appears unique. A particular problem is presented by their orientation, which would suggest left-lateral displacement across the zone rather than the right-lateral displacement that is known to characterize at least the northern end of the province.

339. Butzer, Karl W. CLIMATIC CHANGE IN ARID REGIONS SINCE THE PLEISTOCENE Unesco, Arid Zone Res., No. 17 pp. 31-56, incl. illus., 90 ref., 1961 DWB

Opens with a discussion of the character and variability of climate and general circulation, including present day variability of flow patterns. This is followed by a discussion of pluvial and interpluvial Pleistocene climates and Pleistocene geography of the dry zone of the eastern hemisphere dry zone. The following subchapters are treated: glacial periods in the middle latitude semi-arid zone; pluvials in the subtropical arid lands; pluvials in the tropical or equatorial arid zone; climate of the late glacial and interglacial periods; pluvio-glacial periods in the Americas. Other topics considered are: early Holocene, environment and ecology in Neolithic and early historical times, the post-glacial subpluvial in North Africa and Southwest Asia; early historical desiccation in the Near East; prehistoric climates in American dry lands; climate and its variation in the last 2000 years, including the character of climate in the Near East; the archeological evidence of climatic changes; fluctuation of ground water table; climatic variations in North America from 1000 B.C. to 1850 A.D. and recent climatic fluctuations in arid regions; recent trends in precipitation and temperature in North Africa and Western Asia; climatic fluctuations in the Southern Hemisphere and Central Asia; climatic variability in the US Southwest since 1850. Concludes with a review of the meteorological implications of recent fluctuations and the prospects for future development. Several schematic charts and tables are included.

340. Bryssine, Georges CLIMATIC FACTORS IN PEDOLOGY OF MOROCCO
(Les facteurs climatiques de la pedagenese au Maroc.)
Text in French. Morocco. Service de la Recherche Agronomique
et de l'Experimentation Agricole, Les Cahiers de la Recherche
Agronomique, No. 2 pp. 21-70, incl. tables, graphs, biblio.,
1949 DWB

An elaborate graphical and statistical study of the climate and soils of Morocco based on several systems of classification for pedology. It is shown that the De Martonne aridity index $P/T+10$ and the Lang index $F_p=P/T$ give similar values to widely differing soils. Therefore an index $E_c=P \times T$ is used as indicative of the "climatic energy" which tends to form soils or destroy them. An elaborate chart is presented to show how well the data for 14 soil types in all parts of Europe, Africa and America fit the curves of Ecvor F_p -- an examination of which indicates that through the fit for E_c is not good, that for F_p cuts across, rather than following the lines in almost every case. The actual data for 52 Moroccan stations, 27 in the USSR, 34 in other parts of Europe and the Near East and 17 in Equatorial Africa, with soil types for each, are presented in tabular form. Variations of each index from month to month in Morocco are also shown graphically and, finally, a soil type map for the country presented and characteristics of each zone described.

341. Birot, Pierre, and Jean Dresch PEDIMENTS AND GLACIS IN WESTERN UNITED STATES (Pediments et glacis dans l'Ouest des Etats-Unis.) Text in French. Ann. geographie, v.75, no.411 pp. 513-52, incl. illus., map, 36 ref. Sept/Oct 1966 DLC G1.A6

The authors describe observations made during INQUA excursions on pediments and glacis in the Rocky Mountain basins, the tabular structures of the Colorado Piedmont and the basins of New Mexico and Arizona. The French distinction between pediments and glacis is examined in the region where the latter were first named and defined by McGee. Pediments are defined as erosion surfaces cut into a mechanically hard unweathered rock, which is usually crystalline, while glacis have a substratum of soft unweathered rock. Glacis can be erosional or accumulative in type. An attempt is made to elucidate the processes which create these forms, and to determine their age. Over the large area covered, it is impossible to generalize, and the complexity of the morphology even in the well known Lake Bonneville region, makes it impossible to favor either a glacial or interglacial date for the glacis. It is shown that most pediments post-date the flexures and faults of the Basin and Range area, and these are ascribed to the Pliocene period. The fossilization of

both pediments and glacis is discussed. A small variation of climate especially in the intensity or seasonal distribution of rainfall could cause the crossing of erosion thresholds. The authors submit that the formation of both forms corresponds to increased torrential activity and transport of runoff. They are however unable to decide whether the initiation period is related to glaciation with precipitation increase and temperature decrease, which would favor periglacial activity and abundant debris provision, or perhaps in the North African manner, that glacis accumulation was achieved at the beginning of a dry phase which caused diminution of discharge. They think that the first suggestion is most probable in the American West, but unfortunately, the glacis throughout the study area do not appear to correlate in either date or number. It is however, concluded that the Quaternary chronology both absolute and relative in this region is as yet too coarse for the problem to be definitively solved.

342. Denny, Charles S. ALLUVIAL FANS IN THE DEATH VALLEY REGION, CALIFORNIA AND NEVADA US Geol. Survey, Prof. paper 466, 62 pp., incl. illus., tables, 28 ref. 1965 DLC QE79.P9

Several fans were mapped in detail and some of their characteristic surface features were measured. Most have a complex surface, a mosaic of desert pavements and washes. Bare braided channels and gravel bars form the modern washes. The surface material of the more extensive abandoned washes is coated with desert varnish. Desert pavements are smooth, gently sloping surfaces composed of closely packed angular fragments of rock and traversed by meandering gullies that head in them. Pavements are broken by miniature terraces less than an inch high formed when the underlying silt saturated with water tends to flow down slope and tension cracks -- the risers of the miniature terraces -- form at right angles to the pavement slope. The area of deposition on a fan is equal to $1/3$ to $1/2$ the size of the source area. Fan-building washes have coarse-grained bed materials and steep gradients compared to those that head on fans in areas of desert pavement. Fan-building washes are diverted into those heading on the fan and cause shifts in loci and deposition and erosion. Such diversions are responsible for the complex surface form of most large fans. Alluvial fan formation appears to be related to a condition of dynamic equilibrium between a fan-building wash and its surroundings rather than to a fan's stage of development in some evolutionary sequence.

343. Diaz G. Teodoro and Arsenio Navarro G. LITHOLOGY AND STRATIGRAPHIC CORRELATION OF THE UPPER PALEOZOIC IN THE REGION OF PALOMAS, CHIHUAHUA, MEXICO (Litologia y correlacion estratigrafica del paleozoico superior en la region de Palomas, Chihuahua, Mexico.) Text in Spanish. Assoc. Mexicana geol. petrol., bol., v.16, no.5/6 pp. 107-20, 10 ref. May-June 1964 DLC QE1.A73

Plane-table measurements gave approximately 2400 m of sediments for the Sierra de Palomas, 750 m for the Sierra de Los Chinos, and 800 m for the Sierra de Santa Rita. The sediments of the first can be grouped on the basis of lithologic differences into 9 units whose character and fauna permit correlation with units which in the neighboring Big Hachet Mountains of New Mexico cover a range of formations. The 750 m of the Sierra de Los Chinos consists essentially of dolomites which correspond to the Wolfcampian and Leonardian stages of the Permian. Of the 800 m of the Sierra de Santa Rita, the upper 600 m consists principally of Leonardian dolomites, but also includes, perhaps, the Word stage of the Permian. The lower 200 m is separated from the upper 600 m by 80 m which is buried, and consequently, their true stratigraphic relation is unknown. From top to bottom, these latter are composed of 100 m of very pure arenaceous quartzites and 70 m of dolomite, separated from the basal, arenaceous 30 m by a fault. The geologic column, which correlates with the Pedregosa of Arizona and New Mexico, indicates that the Sierra de Los Chinos asymmetrical faulted anticline is a justifiable wildcat prospect, and that just the worth of the geologic data it would yield would justify the drilling cost.

344. Mabbutt, J.A. DENUDATION CHRONOLOGY IN CENTRAL AUSTRALIA: STRUCTURE, CLIMATE AND LANDFORM INHERITANCE IN THE ALICE SPRINGS AREA In: J.N. Jennings and J.A. Mabbutt (eds) Landform studies from Australia and New Guinea. Canberra Australian National University Press, 1967 pp. 144-81, incl. illus., tables 62 ref. DLC GB381.J4

Because of control by structure and the survival of earlier forms there is no simple relationship between climate and landform development. The survivals include sandplains and sand dunes from relatively recent aridepisodes and rounded upland surfaces and relict duricrusts from wetter periods. After the general structural and environmental background, upland landscapes, duricrusted plains, erosion of the weathered land surface, depositional episodes, dune field and sandplain formation, and the current recovery from the arid phase are treated in turn. The formation of laterite and its alteration to silcrete mark a definite stage in landscape evolution and no subsequent stage has seen comparable weathering. In the northern plains the laterite thickens northward as a climatic response although other factors also have influence.

345. McKee, Edwin D. and Gordon C. Tibbits, Jr. PRIMARY STRUCTURES OF A SEIF DUNE AND ASSOCIATED DEPOSITS IN LIBYA Jour. sedimentol. petrol., v.34, no.1 pp. 5-17, incl. illus., graphs, tables, 5 ref. DLC QE420.J69

Examination of a seif dune, an interdune area, and an adjoining serir near Sebha Oasis in Libya indicates marked differences in texture and structure that should assist in the recognition of such deposits where they are preserved in the geologic record. The seif dune is largely composed of rounded, moderately well sorted, fine-to-coarse-grained sand forming largescale cross strata which dip at high angles in 2 nearly opposite directions. The interdune sand is consistently less well sorted and forms horizontal laminae or strata dipping at low angles. The serir characteristically contains clay, silt, and lag gravels, in addition to sand, giving the samples a double maxima in grade size analyses; it is poorly sorted and is comprised of low angle to horizontal strata, commonly containing carbon fragments or other impurities. Comparison of stratification in the seif dune with that in barchan dunes suggests that it should be possible to differentiate between these 2 types, where they are represented in ancient rocks, through an analysis of dip directions. Distribution of the steeply dipping cross strata of seif dunes to form 2 groups, with essentially opposite dip directions, contrasts with the general unidirectional dips of the steeply dipping cross strata in barchans.

346. Ostrovskii, I.M. EOLIAN FORMS OF RELIEF PARALLEL TO THE WIND (Parallel'nye vetru eolovye formy rel'efa) In: Akad. nauk SSSR. Institut Geografii, Strukturalnaia i klimaticheskaiia geomorfologiya: k shestidesiatiletiu Akademika Innokentia Petrovicha Gerasimova. Moscow, Izdatvo Nauka, 1966, pp. 154-65

Along with the dunes and sand hills which are perpendicular to the wind there are eolian relief forms parallel to the wind which occur on much smaller areas and can be subdivided into positive and negative. Describes and illustrates (photographs) the shapes, sizes and modes of formation of these forms. The positive forms, including hillock-spits and sand mounds, are formed by the splitting of the air current when it approaches large and small obstacles such as rises in the surface or remnants of hills. The negative forms are quite varied and are not confined to arid regions. The author subdivides them into: (1) the more prevalent below-out depressions forming in loose sand and (2) relief shapes formed in the harder substrata (sandy loams, loams, clays, and moist sand). Type (1) is subdivided further into the following groups: (a) depression of indisputable eolian origin entrenched 5-10 m rarely 15 m; (b) depressions 20-30 deep formed by dikes in dry river valleys; and (c) sands deeper than 50 m formed by karst and erosional processes. In forming of groups (b) and (c), wind plays an insignificant role.

347. Morris, Frederik K. ORIGIN OF PEDIMENTS In: Internatl. geol. cong., 19th, Algiers, 1952, compt. rend., sect. 7: Current and ancient deserts, pp. 131-33, Algiers, 1953
DLC QE1.I6 1952b

Author expresses opinion that running water is essential to the formation of pediments as we see them, although an approach to pedimentation could be achieved without any water at all, and under conditions of absolute desert. But important facts have been left without adequate consideration. The work of carving the pediment is often assigned to the moving water and its load of sand -- and the rocks themselves are considered as isotropic, passive things that do not contribute to the rock-destruction. Similarly, the effects of heat, cold, and frost -- especially in deserts where extreme changes of temperature may occur -- are often recognized as agencies that break up the rock, on the assumption that the rocks are passive, except for their physical constants of specific expansion and conductivity. But all rocks are affected by internal stresses. Deep-seated rocks -- either plutonic igneous, or highly metamorphosed -- have expansive stresses when exposed at the surface of the earth. Diagrams and photographs are presented to show that the expansive tendency in all deep-seated crystalline rocks causes them to sheet in large plates rudely parallel to joint planes and to disintegrate into crumbling crystals or bits of rock. As these are washed or blown away, the rock surface becomes lower and approaches the sloping smoothness of a pediment. Sedimentary rocks are affected by internal stresses, but these are caused by the nature and distribution of the cement. In general, the stresses are greatest where the cement has a concretionary distribution, and are less in sediments whose cement is uniformly distributed. Sediments that have internal stresses tend to break up under desert-weathering into fragments or grains, which are easily removed, flattening the hills to form pediments. In general, the concretionary-cemented rocks, or porous sandrocks, or fissile clay-shales (not slates), are readily carved to the form of pediments. The internal structures and stresses in rocks contribute in primary importance to the formation of pediments. Water and wind serve chiefly as agents of removal and distribution of rock-debris, rather than as agents of erosion.

348. Cowles, Raymond B. TRACKS IN DESERT DUNES Nat. hist., v.58
no.5 pp. 206-12, incl. illus., 1949 DLC QH1.N13

The sand dunes in Coachella Valley, California, are best visited in April, May, and October to study tracks of its animal life. The outline of tracks show best in morning or evening when the light rays strike the ground obliquely, thus revealing the slightest disturbance on the dusty surface. Trackers walk toward the sun. Beetles leave outward-toeing prints; scorpions dragging their tails register trails unlike the tarantulas; and jack rabbits walk or run, but cottontails hop. The tracks of the whiptail lizard, Cnemidophorus, have thin, sharply-cut toe markings whereas those of the desert iguana, Dipsosaurus, are larger with a thicker tail mark. The flat-tailed horned lizard has broad "squatty" tracks. Mingled with lizard tracks are the "Maltese cross" tracks of the road runner, and occasionally those of the badger. The spadenosed snake, Chionactis, writes an almost perfectly symmetrical trail of continuous "S" tracks. The side-winder rattlesnake makes a series of parallel diagonal marks as if it were a rolling helix with a 1.5 spiral. After a while the wind brushes all surfaces clean, and an new story is soon written in the sand.

349. Rognon, Perre THE MASSIF OF ATAKOR AND ITS SURROUNDINGS IN THE CENTRAL SAHARA (Le Massif de l'Atakor et ses bordures (Aahara Central).) France. Centre national du recherches scientifiques (CNRS). Center Rescherches sur les zones arides; geologie, v.9, 1967 559 pp., incl. illus., maps, photos, 250 ref. DLC

Describes the geomorphology of part of the Hoggar area of the Sahara. There are many morphological maps, including one of the northern part of the study area (scale 1:200,000) that covers 10,000 km. The Atakor Massif has been interpreted as a major residual in the centre of the Hoggar, and as a relatively young massif of tectono-volcanic origin. It is concluded that it is an ancient mountain area, that owes its internal diversity to differences in rock type related to past volcanic episodes, while the evidence of talus and valley deposits suggests relatively recent rejuvenation of the relief. The denudation chronology is reconstructed, with reference to the summit plain and major levels developed on the basalts. The schists have been eroded into Appalachian relief. The sedimentary sequence of the Hoggar suggests a former Mesozoic cover for Atakor. The varied surface forms developed on the volcanic rocks of Koudia are described: these range from the dissected basalt

plateaus to complex forms, many showing the influence of Quaternary cold climates, on the acid volcanic rocks. Erosion along the flanks of the Massif has produced inselbergs of various sizes and related buttresses in the granites. A final section discusses the contribution of Quaternary tectonic movements to the present relief, the influence of the changing climate of the Quaternary, and the correlation between the climatic-morphologic sequence of the Atakor and that established for the surrounding areas.

350. Richard, Kenyon and J.H. Courtright SOME CRETACEOUS-TERTIARY RELATIONSHIPS IN SOUTHEASTERN ARIZONA AND NEW MEXICO
 Ariz. geol. soc. dig., v.3 pp. 1-7, incl. map., illus.,
 11 ref., March 1960 DLC unbound

In Courtright's report on this subject it was pointed out that the presumed age of certain volcanic rocks described in the literature as Cretaceous was subject to question. It was concluded that the field evidence in the Silver Bell, Stanley, Winkleman-Christmas and other areas indicated that the rocks which frequently have been mapped as Cretaceous volcanics are distinctive in character, being composed predominantly of andesite breccia of probable volcanic-mud-flow origin, and are not interbedded with sediments of certain or probable Cretaceous age. Instead, they are resting on an erosion surface cut in deformed Cretaceous and older sediments, and are probably early Tertiary in age. These andesitic rocks are locally termed the "Silver Bell" formation. Field information accumulated since the first report expands and lends further support to these concepts. The accompanying chart which covers nine localities, including five of those previously reported, shows postulated age relationships and correlations based on lithology and stratigraphic position.

351. Sabins, Floyd F., Jr. THERMAL INFRARED IMAGERY AND ITS APPLICATIONS TO STRUCTURAL MAPPING IN SOUTHERN CALIFORNIA Geol. soc. Amer. bull., v.80, no.3 pp. 397-404, March 1969
 DLC QE1.A2

Thermal infrared imagery is obtained by airborne scanning devices that detect thermal radiation from the earth's surface and record it as an image in which bright tones represent relatively warm temperatures. Scanners sensitive to wavelengths between 8 and 14 microns span the radiant power peak of the earth at 9.7 microns and coincide with an atmospheric "window." An example of 8 to 14 micron nighttime infrared imagery from the Imperial Valley, California, is interpreted and compared with aerial photographs of the

same area. In this monotonous-appearing desert terrain, the imagery exhibits greater contrast and geologic detail than the photography. On the imagery, deformed Tertiary sedimentary bedrock (relatively cool) is distinguished from Holocene windblown sand cover (relatively warm). Of especial geologic interest is a faulted plunging anticline in flat terrain. It is obscure both on aerial photographs and to a ground observer. On nighttime infrared imagery, however, the fold is clearly shown by the outcrop configuration of the individual siltstone and sandstone strata comprising the structure. Apparently the radiometric temperature differences between strata are sufficient to outline the fold on aerial photographs may be due to insufficient contrast in light reflectance between the different strata.

352. Little, Elbert L. SOUTHWESTERN TREES: A GUIDE TO THE NATIVE SPECIES OF NEW MEXICO AND ARIZONA Wash., US Dept. Agric., Handbook 9. 109 pp., incl. illus., maps, 1950
DLC QK484.A6L5

The principal vegetation types of these 2 states are tabulated and mapped. Forests and woodlands combined cover about 25.7% of the area of New Mexico and 26.8% of Arizona. Saw-timber forests alone occupy about 7.8% of New Mexico and 6.5% of Arizona. A considerable part of the saw-timber is, however, noncommercial, because too inaccessible or scattered. In this handbook are descriptions and drawings of 132 spp., of which 99 are found in New Mexico and 126 in Arizona, while 90 occur in both. Data on distribution are given. Many cultivated and ornamental trees are included, although no trees from foreign lands.

353. Millett, John A. and H. Frank Barnett SURFACE MATERIALS AND TERRAIN FEATURES OF YUMA PROVING GROUND (RED HILL, RED BLUFF MT. AND ROLL QUADRANGLES; ARIZONA) Technical report 71-56-ES, US Army Natick Laboratories, Natick, Mass, 01760, June 1971

Distribution of terrain and surface materials mapping units is shown at a scale of 1:62,500 for the Red Hill, Red Bluff Mt., and Roll Quadrangles, as overprints on topographic maps. Six alluvial and five bedrock units are delineated, with testing suitability as the primary consideration. Summary quantitative data on slopes and relief are given for the alluvial mapping units; actual field measurement data totalling 8,500 feet of traverse are included to permit interpretation for specific material evaluation.

354. Millett, John A. and H. Frank Barnett SURFACE MATERIALS AND TERRAIN FEATURES OF YUMA PROVING GROUND (LAGUNA, ARIZONA, CALIFORNIA QUADRANGLE) Technical Report 71-14-ES, US Army Natick Laboratories, Natick, Mass. 01760, October 1970 DDC AD No. 715863

Distribution and slope gradients of surficial materials in the Laguna (Az-Ca) 1:62,500 scale quadrangle were mapped in the field for testing suitability and for comparison of USAYPG terrain with that of other world deserts. Occurrence and topographic expressions of seven alluvial and six bed-rock mapping units are shown as an overprint on the topographic map. Cumulative frequency curves of slope and relief describe these factors of alluvial terrain quantitatively. Actual field measurements of 30,000 feet of traverse are included to permit interpretation for specific materiel evaluation.

355. Weber, W.A. PLANT GEOGRAPHY IN THE SOUTHERN ROCKY MOUNTAINS
In: H.E. Wright Jr. and David G. Frey, The quaternary of the United States Princeton, N.J., Princeton University Press, 1965 pp. 453-68, 68 ref. DLC QE696.W93

The Southern Rocky Mountain flora contains the following elements and sub-elements: (1) Circumpolar, which includes Boreal-Asiatic, Boreal-American, Central Rocky Mountain-Pacific Northwest, and Northern Rocky Mountain sub-elements. (2) Mado-Tertiary, which includes Tertiary-relict, Chihuahuan, Sonoran-Great Basin, and alpine-desert disjunct sub-elements, and (3) Eastern Woodland-Prairie elements. In a broad sense the Cordilleran elements display contracting ranges and the Mado-Tertiary elements expanding ones. Several alpine species that impart a special character to the flora are clearly related to vicariads in the desert steppe. The unique association of Cordilleran, Boreal, and eastern elements in the Black Hills extends sporadically along the east slope of the Rockies through New Mexico to southeast Arizona. Several supposedly ancient species, endemics, and monotypes also occupy this area. Present alpine floras of North American mountain systems probably antedate in part the present arctic flora and demonstrate strong connections with the alpine flora of central-Asiatic mountain systems.

356. Kottowski, Frank E., and others QUATERNARY GEOLOGY OF THE SOUTHWEST In: H.E. Wright Jr and David G. Frey (eds) The Quaternary of the United States Princeton, N.J., Princeton University Press, 1965 pp. 287-98, 86 ref. DLC QE696.W93

Quaternary sediments on the Colorado Plateau and in the southern Basin and Range province of the Southwest (covering Texas, New Mexico, Arizona, southeastern California, southeastern Utah, and southwestern Colorado) include glacial materials in high mountains and the higher plateaus, alluvial and lacustrine sediments in intermontane basins, volcanic accumulations, eolian deposits, paleosols and caliche, and fluvial materials along the Colorado River, Rio Grande, Pecos River, Gila River, and their tributaries. Quaternary events in southern Arizona and southeastern California were controlled mainly by upwarping and subsidence and subordinately by volcanism and climate; climatic changes are recognized chiefly in deposits of late Pleistocene and Recent time. Quaternary alluvial deposits of the Colorado River grade southward into marine sediments in the Gulf of California embayment and thin upstream; however, only a third of the depth of the river's Grand Canyon has been cut during the Quaternary.

357. Bryson, Reid A. THE ANNUAL MARCH OF PRECIPITATION IN ARIZONA, NEW MEXICO AND NORTHWESTERN MEXICO Ariz. Univ. Inst. Atmos. Phys., Tech. repts. on the meteorol. and climatol. of arid regions, No. 6 24 pp., 9 ref. June 7, 1957 DWB

Report is concerned with the annual march of monthly precipitation amount in an area comprising the states of Arizona, New Mexico, Sonora, Sinaloa, Durango, and western Chihuahua. Fourier analysis was used to reduce the twenty-year mean monthly values to six harmonic terms, four of which were then plotted on charts and studied. The results of this study indicate that an area consisting largely of the Sierra Madre Occidental in northwestern Mexico, and the portion of Arizona southeast of Tucson constitute a single rainfall province with a strong summer maximum of rainfall. This province also has a winter maximum, but only in Arizona does the semi-annual term exceed the annual in amplitude. Within the US, the Gila and Rio Grande valleys constitute rainfall provinces of internally similar annual march, while the upland areas tend to resemble the Pacific coastal pattern to the west.

358. Cameron, R.E. and G.B. Blank DESERT ALGAE: SOIL CRUSTS AND DIAPHANOUS SUBSTRATA AS ALGAL HABITATS Calif. Inst. Tech., Jet Propulsion Lab., Pasadena, Calif., Tech. rept. 32-971 41 pp., incl. illus., 137 ref. July 15, 1966
DLC QK938.D4C35

In terrestrial desert environments, favorable microenvironments are found in the soil that promote the development of algae and associated organisms and a subsequent accumulation of organic matter. The most favorable habitats occur in algal and lichen soil crusts, and on the undersurface of translucent material partially imbedded in the soil surface. Algal abundance is increased and ecological factors are much less restrictive in these ecological niches than in the surrounding desert soil. Insolation is modified, more moisture is retained, dessication is reduced, and organic matter accumulations are noticeable. Characteristics of translucent materials, such as white or milky quartz and chalcedony, which are partially imbedded in the surface of desert soils, permit the existence of mesophilic algal inhabitants, such as species of coccoid, blue-green algae, that do not normally occur as components of xeric soil populations. Other species are cosmopolitan forms occurring in a wide range of environments. Much of the study for this report was carried on in the Sonoran Desert.

359. Breazeale, J.F. and H.V. Smith CALICHE IN ARIZONA Ariz. Univ. Agric. exper. sta., bull. 131 April 15, 1930 pp. 419-41, 6 ref. DLC S35.E18

Caliche, a calcareous hardpan, is widely distributed in southern Arizona, particularly between the Santa Cruz and Rillito Rivers near Tucson, and in the same type of lands near Phoenix. The chemical and physical nature of these deposits, and the different conditions under which they were formed are discussed. Research has led to the following conclusions: (1) caliche, wherever found in Arizona, was formed by the solution, transportation, and precipitation of calcium carbonate; (2) water, when charged with calcium dioxide, dissolves calcium carbonate and forms calcium bicarbonate. The calcium bicarbonate is carried in solution and is precipitated as calcium carbonate, or caliche, when the water is evaporated, or when there is a relief in pressure, which drives off the calcium dioxide; (3) caliche strata may be formed beneath the surface of a soil, either by evaporation of descending surface water, or by the evaporation of ascending ground water; (4) caliche may be formed in a soil by means of plant roots; (5) as long as they

are permeable to water, caliche strata will move downward in a soil as fast as erosion removes the upper soil surface; and (6) caliche probably is formed upon the surface of a soil by the evaporation of surface or flood water. The formation under such conditions is hastened by the presence of algae and other water plants.

360. Reitan, Clayton H. and Christine R. Green WEATHER AND CLIMATE Vol. 2 in An Inventory of Geographical Research on Desert Environments, Office of Arid Lands Research, Univ. of Ariz., Tucson, Ariz., 1967 72 pp., 100+ ref. AD 664641

The inventory includes a general discussion on the availability of climatic data. Discussions of weather systems, dust and sand storms, upper air circulations, aridity, weather modification, microclimate, and radiation. The North American deserts are included as a sub-category, with several references to the Sonoran Desert.

361. Lustig, Lawrence K. INVENTORY OF RESEARCH ON GEOMORPHOLOGY AND SURFACE HYDROLOGY OF DESERT ENVIRONMENTS Chapter IV of An inventory of geographical research on desert environments Arizona University. Office of Arid Lands Studies, 1967 189 pp., 100+ ref. (US Army Natick Labs., TP 291) AD 664 643

This chapter concentrates particularly on the following aspects of surface configuration and drainage features: (1) information of a descriptive or qualitative nature; (2) quantitative data on desert landforms or drainage features; (3) information on geomorphic mapping; (4) information on Army research efforts; and (5) information on general principles of landform or drainage development and the empirical relationships involved. Besides a discussion of the availability of information for each of the major deserts, the report considers the background of modern geomorphic concepts, and provides evaluations and recommendations regarding the deficiencies of information and basic problems. Contains an exhaustive bibliography, with frequent annotations.

362. Dregne, Harold E. INVENTORY OF RESEARCH ON SURFACE MATERIALS OF DESERT ENVIRONMENTS Chapter V of, An inventory of geographical research on desert environments. Arizona Univ. Office of Arid Lands Studies, 1967 91 pp., 100+ ref. (US Army Natick Labs., TP 335) AD 664013

In this chapter, the term surface material refers to the organic and inorganic portion of the earth's crust that lies within 5 feet of the surface. It is not always synonymous with "soil" because some surface materials may be altered significantly from what they were when originally deposited or exposed. The objective is to review, appraise and recommend research on the solid phase of the crust, treating material relevant to the arid zone. Contents: Discussion of the state of knowledge regarding the principal soils and soil surveys of the major deserts; authorities and depositories; biological properties; physical properties; chemical properties; soil classification; conclusions and recommendations; and pertinent publications.

363. McGinnies, William G. VEGETATION, Vol. 6 in An Inventory of Geographical Research on Desert Environments, Office of Arid Lands Studies, Univ. of Ariz., Tucson, Arizona 1967 184 pp., 100+ ref. AD 668 852

The report includes a general discussion of desert vegetation characteristics, description methodology, qualities, and the availability of data, with separate sections on the North American Desert including the Sonoran. Included are a bibliography and an extensive species summary including authors, species' family, deserts and habitats where found and growth and life forms.

364. Lowe, Charles H. FAUNA Vol. 7 in An Inventory of Geographical Research on Desert Environments, Office of Arid Lands Studies Univ. of Ariz., Tucson, Arizona 1968 77 pp., 100+ ref.

The report includes a general discussion of desert organisms, sources and evaluation of knowledge, poisonous animals, fauna as human foods, native animals as pests, diseases in the desert, various tables and a bibliography. Very limited data on species distribution for the North American (including Sonoran) Deserts.

365. Cunningham, G.L., and B.R. Strain AN ECOLOGICAL SIGNIFICANCE OF SEASONAL LEAF VARIABILITY IN A DESERT SHRUB Ecology, v.50, no. 3 pp. 400-408, incl. illus., tables, graphs, map, ref. Spring 1969 DLC QH540.E3

Encelia farinosa is one of a number of species of desert perennial shrubs in which individuals exhibit considerable seasonal variation in the amount and structure of leaf tissue. The function of seasonal leaf variability in adapting this species to the desert environment was investigated. Field observations in the Sonoran Desert region demonstrated that leaf quantity and structure are controlled by the moisture status of the environment. Field observations also established the influence which leaf quantity and structure have on the CO₂ exchange capacity and water status of the shrub. These observations were corroborated by laboratory experiments. The laboratory investigations also indicated that the influences of leaf structure are brought about by alterations in the resistance to CO₂ and water vapor diffusion.

366. Bull, William C. ALLUVIAL FANS Jour. Geologic. educ., v.16, no.3 pp. 101-106, incl. illus., 20 ref., 1968
DLC QE40.J6

Deposition occurs on fans because of changes in hydraulic geometry where a stream ceases to be constricted in a truck channel, as it leaves the mountains. Deposition is by channels which constantly change position, by mudflows, and by "sieve" deposition where water seeps into porous deposits. Channels may entrench the upper part of a fan, restricting deposition to its outer margin. Such entrenchment may be temporary, related to increased frequency of high-intensity rainfall, or permanent, from continued down-cutting by the stream in the mountains. Fan area is proportional to the 0.9 power of drainage basin area; the coefficient of proportionality has more than ten-fold variation, because of the effect of lithology, climate, history and available space. Fans from areas of faster erosion, mudflow and sieve rather than fluvial deposition, or smaller streams, tend to be steeper. Fan surface are convex in plan but concave in profile, and can be described by a quadratic equation.

367. Dunning, Charles H. and Edward H. Peplow, Jr. ROCKS TO RICHES: THE STORY OF AMERICAN MINING . . . PAST, PRESENT AND FUTURE . . . AS REFLECTED IN THE COLORFUL HISTORY OF MINING IN ARIZONA, THE NATION'S GREATEST BONANZA Phoenix, Southwest Pub. Co., 1959 406 pp. DLC TN24.A6D8

Mining engineer Dunning reviews the mining history of Arizona, period by period, from Spanish times down to 1957. Metal mining gets fullest treatment; also included are statistical tables of production, a brief glossary, and an annotated list of about 250 notable Arizona mines.

368. Mowry, S. ARIZONA AND SONORA: THE GEOGRAPHY, HISTORY, AND RESOURCES OF THE SILVER REGION OF NORTH AMERICA New York Harper and Bros., 1871 251 pp. DLC F811.M95

Mowry, a mine owner and politically minded frontiersman, describes in some detail, many of the silver mines and prospects of Arizona and Sonora. He claims accuracy of statement, the entire absence of exaggeration, and claims also that he went to great pains to verify the facts. No photos or maps are included in this 1871 publication though most of the locations mentioned are close to culture and can probably be located accurately. The minerology and geology are given in detail for most mines. He also discusses history, production figures, Arizona politics and Mexican mining conditions and prospects. (Historical interest only.)

369. Kangieser, Paul C. and Christine R. Green PROBABILITIES OF PRECIPITATION AT SELECTED POINTS IN ARIZONA Ariz. Univ. Inst. Atmos. Phys., Tech. repts. on meteorol. and climatol. of arid regions, No. 16 8 pp., plus append., incl. tables, graph, map, 6 ref., April 15, 1965 DLC QC993.7.T4

This report presents empirical probabilities that the amount of precipitation (inches) during each month of the year will be less than a computed amount. Similar probability values are also presented for the annual series. The probability levels are 10%, 25%, 50%, 75%, 90%, and 95%. The calculations were limited to stations appearing in Green and Sellers (1964). Only stations from that publication are included which had homogeneous records of at least 25 years (73 stations).

370. Gorsline, D.S. SEDIMENTOLOGICAL STUDIES OF THE COLORADO DELTA Southern Calif., Univ., Los Angeles, Dept. of Geol., Rept. no. USC-GEOL-67-1, March 1967 121 pp. AD 655 631

Reviews the work accomplished under the original contract including literature review, sedimentologic data analysis, and surficial characteristics of the Colorado Delta with emphasis on the lower portions of the delta. This special climatic setting produces a very different assemblage of surficial types with barren mud flats predominating, and salinas second in importance but with marshes a negligible type in contrast to most other major deltas such as that of the Mississippi River where marshes are the dominant surficial form. The lack of peat deposits may also contribute to the much less evident compaction subsidence of the delta and the relatively stable form of the feature since its first exploration some four centuries ago. A second unusual condition is that the delta is situated in the graben formed by one of the major active fault systems of the world. Thus faulting and active movement of a tectonic nature are the major influences on the form of the delta. Traces of scarps can be seen on aerial photographs of the deltaic plain. Several problems are evident for future research including a study of the clay mineralogy of this delta, particularly in areas of exceptionally high salinity; tectonic effects on sedimentation; and rates of accretion.

371. Johnson, Burdetta F. (Beebe) AMERICAN DESERT ANIMALS N.Y. David McKay Co., Inc., 1966 183 pp. QL116.J6

Armadillos, javelinas, coatis, kangaroo rats, prairie dogs, ringtails, pack rats, and bighorn sheep are included. Environment, food habits, breeding habits, sociability and other items are discussed. There is a bibliography and a subject index.

372. Jaeger, Edmund C. DESERT WILDLIFE (rev. ed. of OUR DESERT NEIGHBORS) LC 61-16884, 1961 (reprinted 1965) Stanford Univ. Press, Stanford, California 308 pp.

A series of sketches depicting the lives of Southwestern Desert native animals, with especially full treatment to mammals and birds.

374. Burt, William Henry and Richard Philip Grossenheider
FIELD GUIDE TO THE MAMMALS, 2nd Ed. rev. Peterson Field
Guide Series, No. 5, Houghton Mifflin Co., Boston, 1964
LC 63-8125; ISBN: 0-395-0747-1 284 pp, 32 photos, 291
maps, 93 ref.

Lists over 300 species and subspecies with distribution maps for the majority, and colored illustrations for the more important. Narratives include discussion of families and economic state, and for species recognition data, habitat and habit data and notes on young. Illustrations of skulls and dental formulae are also included. One of two basic references (see also 76) on mammals for the inventory.

375. Cockrum, E. Lendell RECENT MAMMALS OF ARIZONA: THEIR TAX-
ONOMY AND DISTRIBUTION Univ. of Ariz. Press, Tucson, Ariz.
1960 LC 60-15914 276 pp., 112 fig., maps, 245 ref.

The mammals currently recognized as occurring in Arizona are classified as 290 different kinds (species and subspecies) representing 135 species, 63 genera, 23 families, and 7 orders. For each named kind of mammal a synonymy is given which includes: (1) the citation of the original description; (2) the citation to the first useage of the name combination recognized by the author as being current; and (3) the name combinations that have been used in the past in reference to this animal in Arizona. The type locality is given as a part of the citation of the original description. Following the synonymy is a general statement of the distribution, and a reference to the map that shows the points where specimens have actually been taken. This is followed by a listing of the specimens personally examined, and for some kinds, locality records from the literature when pertinent specimens have not been examined. This is one of two basic references (see also 75) used in the mammal inventory.

turtles, 41 are lizards and 48 are snakes. Birds are represented by 434 species, and mammals by 137 species. The various checklists provide brief to extended notes on occurrence, habitat, distribution, and other matters of interest.

377. Howes, Paul Griswold GIANT CACTUS FOREST AND ITS WORLD: A BRIEF BIOLOGY OF THE GIANT CACTUS FOREST OF OUR AMERICAN SOUTHWEST New York, Duell, Sloan & Pearce, 1954
LC No. 54-6888 258 pp., 51 photos, 30 fig., 28 ref.

Excellent description and photographs of some of the varieties of cacti to be found in southwestern Arizona are provided. The author was curator of the Bruce Museum of Greenwich, Conn. at the time of this publication. Emphasis is on the flora and fauna associated with the Saguaro Cactus. Includes lists of mammals, birds, reptiles, amphibians, and anthropods.

378. Musick, H. Brad A STUDY TO EXPLORE THE USE OF ORBITAL REMOTE SENSING TO DETERMINE NATIVE AND PLANT DISTRIBUTION Type II Progress report, (MMC No. 250; GSFC # UN613) Tucson, Office of Arid Lands Studies, Univ. of Ariz. 15 August 1973

Plant distribution, remote sensing, plants.

379. Fowlie, Jack A. SNAKES OF ARIZONA Fallbrook, Calif., Azul Quinta Press, 1965 164 pp., 82 illu., 82 maps

A compendium of information on snakes occurring in Arizona including distribution (essentially localities) maps, taxonomies, descriptions and illustrations. Due to internal discrepancies and lack of an index, used as a supplement to other works for the purposes of the inventory.

380. US Fish and Wildlife Service PRONGHORN ANTELOPE Conservation Note 11, GPO (911-069) Government Printing Office, Washington DC, Revised February 1966
381. MAMMALS OF KOFA GAME RANGE Pamphlet RF-23511-3, Dept. of the Interior, September 1974
382. BIRDS OF HAVASU NATIONAL WILDLIFE REFUGE Pamphlet RF-2351000-2-R5, GPO 848-773, Government Printing Office, Washington DC, July 1973
383. BIRDS OF IMPERIAL NATIONAL WILDLIFE REFUGE Pamphlet RL-159-R-4, GPO 837-849, Government Printing Office, Washington DC, rev. September 1971
384. BIRDS OF THE CABEZA PRIETA GAME RANGE Pamphlet RL-196-R, Dept. of Interior, rev., December 1965
385. BIRDS OF THE KOFA GAME RANGE Pamphlet RL-199-R-2, Dept. of Interior, rev. December 1965
386. MAMMALS OF THE IMPERIAL NATIONAL WILDLIFE REFUGE Pamphlet RL-314-R1, Dept. of Interior, rev. October 1971
387. Pearson, T. Gilbert (ed) BIRDS OF AMERICA New York: Doubleday, Doran L Co., (Garden City Publishing Co.) 1936
270+ 240+ 267 pp., 106 pl., figs., biblio.
388. Phillips, Allen, et al BIRDS OF ARIZONA Tucson, Univ. of Arizona Press, 1964 ISBN 0-8165-0012-6

389. Olin, George and Edward Bierly MAMMALS OF THE SOUTHWEST
MOUNTAINS AND MESAS Popular Series No. 9, Southwestern
monuments Association, Globe, Arizona 1961 126 pp.,
50 illus., 30 maps, 11 ref. LC 61-11291

A popular presentation including small scale distribution maps and descriptions of mammals found in Arizona, New Mexico, Colorado and Utah in and above the upper Sonoran life zone (above 4,500 feet and above; see also 115). For the purpose of the inventory, does not add to Burt and Grossenheider (75) and Cockrum (76).

390. Olin, George and J. Cannon MAMMALS OF THE SOUTHWEST DESERTS
3rd Ed. rev. Popular Series Southwestern Monuments Assoc.
Globe, Arizona 1959

A popular presentation including small scale distribution maps and descriptions of mammals found in Arizona, New Mexico, Colorado and Utah in the lower Sonoran life zone (up to about 4,500 feet, see also 114). For the purpose of the inventory, does not add to Burt and Grossenheider (75) and Cockrum (76).

391. Frost, R.E. 1955 TERRAIN STUDY OF THE YUMA TEST STATION AREA,
ARIZONA Unpublished report, Waterway Experiment Station,
Vicksburg, Mississippi, 176 pp.

A detailed report of the YTS area of the Corps of Engineers concerned with physiography, geology, climate, terrain classification, landforms, and soils. Brief information presented on soils, soil consistency and vegetation. Thorough analysis of the terrain and geology. Contains a fairly good bibliography and numerous excellent photographs and several maps. (Frequently referred to as the "Perdue Study").

392. Nelson, Ronald A. ANALOGS OF YUMA CLIMATE IN NORTH AMERICA (Yuma Analogs, No. 8) US Quartermaster Res. & Engnrng. Command, Res. study rept. no. RER-12, Jan. 1957 33 pp., incl. illus., tables AD 200 851

A close analogy to Yuma climate exists in SE California, SW Arizona, and in adjoining parts of Mexico. Warmest month temperature analogy occurs generally in arid and semiarid regions of the study area. Coldest month temperature analogy occurs generally in the lower latitudes of the study area. Along the western littoral of the US, which is relatively warm in winter, close temperature analogy extends to approximately 38°N. Areas of precipitation analogy coincide closely with the Sonoran and Mojave Deserts, and several small areas are also closely analogous. Only Death Valley is significantly drier. Analogous wind speeds are distributed generally over most of the study area, but local terrain differences cause much variation in speed and direction. Areas of analogy of pertinent climatic elements are presented in a series of maps.

393. MacDougal, D.T. THE DELTA OF THE RIO COLORADO Amer. geogr. soc. bull., v.38 pp. 1-16, 1906 DLC G1

An excellent early description of the physiography, vegetation, and inhabitants of the lower delta (Mexico), with maps.

394. US National Aeronautics and Space Administration, Science and Technology Information Division

EARTH PHOTOGRAPHS FROM GEMINI III, IV AND V Its Spec.
pub. SP-129, 266 pp., incl. illus., 1967 DLC QB637.U55

Gemini IV and V carried Synoptic Terrain Photography and Synoptic Weather Photograph experiments. Gemini IV photographed areas of east Africa, the Arabian Peninsula, Mexico and the southwestern US; Gemini V, selected land and near-shore areas of oceanographic interest. 244 photographs reproduced including 39 near-vertical views of the Pacific coast of Mexico to central Texas which show such details as contact between Quaternary alluvium and bedrock, fault zones, tectonic provinces in Sonora and sediment distribution in the Colorado River delta. Other photographs show shallow-water topography off the Bahamas, reef areas in the Marshalls, and deposition patterns in some north African sand dunes. Captions indicate locations of photographs; an appendix provides orbital data.

395. Stone, Richard O. A DESERT GLOSSARY Earth-sci. review, v.3
no.4 pp. 211-68, 1967 DLC QE1.E14

The vocabulary describing desert features and desert phenomena is vast and, in various respects, repetitious. Presents a compilation of current terms with the intention to assist individuals interested in deserts to more easily understand published information and to provide a single source which can be enlarged in the future.

396. Assoc. of Engineering Geologists (Los Angeles Sec.)
SEMINAR ON THE IMPORTANCE OF THE EARTH SCIENCES TO THE PUBLIC WORKS AND BUILDING OFFICIAL National meeting, Anaheim, Calif., 1966. Glendale, Calif., Assoc. Eng. Geologists, Los Angeles Sec. 465 pp., 1966

The purpose of the seminar is to obtain the most recent data involving topics of interest to public officials; to outline some of the considerations which should provide continued improvement of supervision of hillside urban development; and to align the direction in which this improvement should proceed. One paper is relevant to desert environment studies; Roberts, Don V. and Gary E. Melickian, Geologic and other natural hazards in desert areas, pp. 315-350 (abstracted elsewhere under D.V. Roberts).

397. Richard, Kenyon and James H. Courtright STRUCTURE AND MINERALIZATION AT SILVER BELL, ARIZONA In Geology of the porphyry copper deposits, Southwestern North America, ed. by S.R. Titley and C.L. Hicks. Tucson, Univ. of Ariz. Press 1966 pp. 157-63, incl. illus., map, ref. DLC QE79.5T55

Production at the Silver Bell mining district began with opening of Boot mine, later known as Mammoth, in 1865. At present about 18,000 tons of copper are being produced annually. Copper mineralization occurs along the flank of the Silver Bell Mts. in hydrothermally altered intrusive rocks. The zone of alteration follows an alignment, hidden by the Laramide intrusions, but parallel to two major faults. Several thousand feet each of Paleozoic and Cretaceous rocks are present. Three units of early Tertiary (?) volcanic and sedimentary rocks are recognized. Intrusive activity is described. Structural control of hypogene mineralization, supergene enrichment, and leached outcrops are discussed.

398. Kerr, Paul F. ALTERATION FEATURES AT SILVER BELL, ARIZONA Geol. soc. amer., bull., v.62, no.5 pp. 451-80, incl. illus., maps, 20 ref., May 1951 DLC QE1.G2

At the Silver Bell Range, two Cu deposits have been explored, Oxide on the south end of the Range and El Tiro 3 miles northwest. Both are essentially disseminated deposits and exhibit a series of hydrothermal metamorphic stages superimposed upon a variety of geologic conditions. Early mined copper ores were largely formed by contact-metamorphic action along the boundaries between dacite porphyry or quartz monzonite and Paleozoic limestones. The contact deposits in the Mammoth-Union area at Silver Bell and

pockets at El Tiro reportedly produced 100,000,000 pounds of copper. Disseminated ores explored in this investigation differ from the contact ores in being largely associated with quartz monzonite and to a minor extent dacite porphyry or dacite. Major deformation has resulted in faulting of Precambrian alaskite on the southwest against Paleozoic sediments on the northeast. Major post-Paleozoic igneous activity has involved a dacite flow, a dacite porphyry intrusive, and quartz monzonite in sequence. Minor intrusive activity is represented by a series of dikes invading previously formed rocks and frequently following fault lines. Hydrothermal copper-depositing solutions which followed the quartz monzonite have produced a halo of alteration minerals in alaskite, quartz monzonite, and the two dacites. The effects are observable chiefly in the quartz monzonite, but with equal intensity in limited areas of the other igneous rocks. Convergence in metamorphism with ultimate quartz-sericite mass replacement may be observed in all four rocks. The alteration minerals are kaolinite, halloysite, montmorillonite, illite (or hydro-mica), sericite, chlorite, alunite, jarosite, barite, opal, secondary quartz, and adularia. Field criteria confirmed by laboratory study have been used to divide the four igneous rock types into alteration stages. An alteration map of the entire mineralized area shows these stages, and significant portions of the map are reproduced in the paper.

399. Sykes, Godfrey THE DELTA AND ESTUARY OF THE COLORADO RIVER
Geogr. rev., v.16 pp. 232-55, 1926 DLC G1.G35

This article is interesting from the historical point of view, by providing information on changes in the delta and estuary of the river for the past 100 years, and on the formation of the Salton Sea.

400. Arizona Geological Society SOUTHERN ARIZONA GUIDEBOOK II
Combined with the 2nd annual Arizona Geological Society
Digest. Edited by L.A. Heindl. Tucson, April 1959,
290 pp., incl. illus., tables, maps, 316 ref.
DLC QE85.A7A3

Arizona includes parts of the Basin and Range and Colorado Plateau provinces. The contrast in the physiography of the 2 provinces is based principally on differences in structural complexity -- rocks of the Colorado Plateau province are only moderately deformed; the rocks of the Basin and Range province, and particularly those older than late Tertiary are intensely folded, faulted and intruded. Although the Basin and Range province is topographically lower than the Colorado Plateau province, it is structurally higher, and the boundary between the 2 provinces is the structurally highest part of the state. The boundary forms a comparatively narrow zone of mountainous terrain, along which Precambrian rocks stand up to several thousand feet above Precambrian rocks on either side. Southern Arizona is generally limited to that part of the state that lies within the Basin and Range province south and west of the boundary, and the distribution and history of the rocks of this region are outlined broadly in this introduction. This valuable work includes the following articles relevant to the project: Mitcham, Thomas W., Viking Rocket Photograph of Arizona, California and Northern Mexico West of Tucson, Arizona, p. xviii-xix; Heindl, L.A., Introduction, p. 1-4; Pye, Willard D., Marine Sedimentation in Southern Arizona, p. 5-11; Damon, Paul E., Geochemical Dating of Igneous and Metamorphic Rocks in Arizona, p. 16-20; Thomas, George C., The Mississippian System in Southern Arizona, p. 31-34; Bryant, Donald L., Marker Zones in Permian Formations of Southern Arizona, p. 38-42; Kinnison, John E., Chaotic Breccias in the Tucson Mountains, Arizona, p. 49-57; Wood, Paul A., Tertiary Deposits in Southern Arizona, p. 58-61;

Johnson, Phillip W., Test Holes in Southern Arizona Valleys, p. 62-65; McClymonds, Neal E., Paleozoic Stratigraphy of the Waterman Mountains, Pima County, Arizona, p. 67-76; McClymonds, Neal E., Precambrian and Paleozoic Sedimentary Rocks on the Papago Indian Reservation, Arizona, p. 77-84; Titley, Spencer R., Igneous Rocks of the Basin and Range Province in Arizona, p. 85-88; Wilson, Eldred D., and Richard T. Moore, Structure of Basin and Range Province in Arizona, p. 89-105; DuBois, Robert L., Geology of the Santa Catalina Mountains, p. 107-116; DuBois, Robert L., Petrography and Structure of a Part of the Gneissic Complex of the Santa Catalina Mountains, Arizona, p. 117-126; Galbraith, Frederic W., The Empire Mountains, Pima County, Arizona, p. 127-133; Mayo, Evans B., Volcanic Geology of the Northern Chiricahua Mountains, p. 135-138; Cooper, John R., Some Geologic Features of the Dragoon Quadrangle, Arizona, p. 139-145; Kennison, John E., Structure of the Saginaw Area, Tucson Mountains Arizona, p. 146-151; Heindl, L.A., Geology of the San Xavier Indian Reservation, Arizona, p. 153-159; Galbraith, Frederic W., Craters of the Pinacates, p. 161-164; Jahns, Richard H., Collapse Depressions of the Pinacate Volcanic Field, Sonora Mexico, p. 165-184; Lacy, Willard C., Structure and Ore Deposits of the East Sierrita Area, p. 185-192; Journeay, J.A., Pyrometasmatic Deposits at Pima Mine, p. 198-199; Richard, Kenyon, and James H. Courtright, Some Geologic Features of the Mission Copper Deposit, p. 201-204; Schmitt, Harrison A., Donn M. Clippinger, William J. Roper, and Harvey Toombs, Disseminated Deposits at the Esperanza Copper Mine, p. 205; Field Trip Road Logs: Structure and Ore Deposits of the East Side of the Sierrita Mountains, Trip I, Road Log, Thursday April 2, 1959, p. 207-211; Stratigraphy of the Waterman and Silver Bell Mountains, Trip II, Road Log, Thursday April 2, 1959, p. 213-217; Santa Catalina Mountains, Trip III, Road Log, Thursday April 2, 1959, p. 219-223; Chaotic Breccia in the Tucson Mountains, Trip IV, Road Log, Thursday April 2, 1959, p. 225-226; General Geology of Southeastern Arizona, Trip V, Road Log, First Day, Sunday April 5, 1959, p. 227-238; General Geology of Southeastern Arizona, Trip V, Road Log (cont.), Second Day, April 6, 1959, p. 239-251; Volcanic Craters of the Pinacate Mountains, Sonora, Mexico, Trip VI, Road Log, First Day, Sunday April 5, 1959, p. 253-270; Volcanic Craters of the Pinacate Mountains, Sonora, Mexico, Trip VI, Road Log (cont), Second Day, Monday April 6, 1959, p. 271-272. Miscellaneous Items: Pye, Willard D., Catalog of Principal Sedimentary Formation Names in Southern Arizona and Northern Sonora, p. 274-281.

401. Al Naqib, K.M. GEOLOGY OF THE ARABIAN PENINSULA -- SOUTH-WESTERN IRAQ Geological Survey Professional Paper 560-G, 54 pp., 1967

A review of the geology of southwestern Iraq. The data provided by the maps and in the professional paper provide information for an orderly scientific and economic development of a subcontinent. SW Iraq covers all Iraqi territory south of latitude 32°N and W of the Euphrates River.

402. Shields, Lora M. and Linton J. Gardner (eds.) BIOECOLOGY OF THE ARID AND SEMIARID LANDS OF THE SOUTHWEST. Symposium Held at New Mexico Highlands University During 34th Annual Meeting of the Southwestern and Rocky Mountain Division of the AAAS and the New Mexico Academy of Science. Las Vegas, New Mexico Highlands University, Bull. No. 212, 1961, 69 pp. DLC DWB (M86 S989sy)

Designed largely for the nonspecialist. Data on climatic zones of the southwest, on responses of plants to various climatic elements and on climatic morphology of the region are included. The importance of climatic elements in regional ecological development is stressed throughout.

403. Aguilar y Santillan, Rafael BIBLIOGRAPHY OF MEXICAN GEOLOGY AND MINING Amer. inst. mining & metallurg. engineers, trans., v.32 pp. 605-80, 1901 DLC TN1.A5

A bibliographic review of all the work that had been done in Mexico in the field of geology as well as mining prior to 1902. Approximately 1950 entries are provided, many of them concerned with remote and very limited areas of mines and minerals. Items are arranged alphabetically under authors' names. An index of the principal localities covered in the bibliography is included. A good basic bibliography for early works that cover the states of Sonora and Chihuahua and many localities within them.

404. Bryan, Kirk THE PAPAGO COUNTRY, ARIZONA. A GEOGRAPHIC, GEOLOGIC, AND HYDROLOGIC RECONNAISSANCE WITH A GUIDE TO DESERT WATERING PLACES US Geol. Survey, Water-supply paper 499, 436 pp., incl. illus., maps (in pocket), 1925 DLC TC801.U2

The Papago country as considered in this report includes the part of the original Papagueria (the region inhabited by the Papago Indians west of the Santa Cruz River) which lies north of the Mexican-US boundary, and is bounded by the Santa Cruz, Gila and Colorado rivers, but includes also the routes from Tucson to Florence, Casa Grande to Florence and Florence to Phoenix. The report treats the history, Papago Indians, climate, flora and fauna, the geology, physiography, surface and ground water conditions, and then presents road logs of all major routes through the region with extensive descriptions of localities along the routes.

405. Matthews, J. Brian AN UNUSUAL TYPE OF LIGHTNING Weather, v.19, no.9 pp. 291-92, 3 ref., September 1964
DLC QC851.W4

On March 3, 1964, Tucson, Arizona suffered a snowstorm, an unusual event for this locale, which exhibited an even more unusual form of electrical discharge. Short flashes of lightning were seen to be occurring at intervals estimated to be about 15-20 sec and at random places around the town. The flashes contained several unusual features; they appeared to be single, short flashes of light without the flicker normally associated with lightning. They were less intense than normal lightning and were not observed to cast sharp shadows. Moreover thunder was not heard at any time, nor could correlation between the flashes and static over the radio be found. Possible explanations are suggested. Most probable is that small pockets of electric charge were carried down to the Earth by wet snow.

406. Thomas, Joseph Cox A BEHAVIORAL AND ECOLOGICAL STUDY OF THE DESERT PUFFISH -- CYPRINODON MACULARIUS, IN QUITOBAQUITO SPRINGS, ORGAN PIPE CACTUS NATIONAL MONUMENT, ARIZONA Ariz. Univ., Ph.D. thesis, 1966. Order from: University Microfilms, Ann Arbor, Mich., Order No. 67-3965 102 pp. mi \$3.00 ph \$5.20

The ecology and behavior of the form of desert pupfish, Cyprinodon macularius, found in Quitobaquito Springs, Organ Pipe Cactus National Monument, Arizona, were studied during 1964 and 1965. Historical aspects of the environment were discussed. Ecological changes were found to take place rapidly in this environment; level and turbidity changed with a great deal of speed having decided effects on the breeding fishes.

407. Stamp, Dudley L. ARID ZONE PROBLEMS Discovery, v.23, no.9 pp. 23-25, September 1962 DLC

In the development of arid zones, it is generally assumed that irrigation is the first need. The dangers of certain irrigation projects and the need for the development of large scale, highly advanced, farming methods are not so well understood. Dam projects often involve the drowning of a large amount of arable land; in addition, silt brought down by the river which would normally increase the fertility of the land in the lower reaches of the river is trapped in the reservoir. Evaporation and salinity are other problems to be contended with. Much fresh thinking is needed.

408. Bikerman, M. ISOTOPIC STUDIES IN THE ROSKRUGE MOUNTAINS, PIMA COUNTY, ARIZONA Geol. soc. Amer., bull., v.78, no.8 pp. 1029-36, August 1967 DLC QE1.G2

K-Ar dating of igneous rock units in the Roskrige Mountains indicates that periodic activity occurred in mid-Cretaceous time, during the late-Cretaceous-early-Tertiary (Laramide) interval, and in mid-Tertiary time. The general sequence of rock types and periods of activity are very similar to those in the adjacent Tucson Mountains.

409. Wells, Philip V. LATE PLEISTOCENE VEGETATION AND DEGREE OF PLUVIAL CLIMATIC CHANGE IN THE CHIHUAHUA DESERT Science v. 153, no.3739 pp. 970-75, ref., Aug. 26, 1966 DLC Q1.S35

Eight Pleistocene wood rat middens at elevations of 1200, 880, and 600 m in the Chihuahuan Desert contain abundant macrofossils of pinyon pine, juniper, shrubby liveoak, and Opuntia, together with smaller quantities of Agave lecheguilla and other xerophytes of existing desert vegetation, which indicates a xerophilous woodland vegetation in the lowlands, as much as 800 m below existing woodland, during the Wisconsin pluvial. Ten radio-carbon dates show ages that range from 11,560 to 14,800 and 16,250 to 20,000 yrs., and to more than 40,000 yrs. Absence of most mesophytic montane species in deposits as high as 1200 m indicates a lack of equivalent downward displacement for the ponderosa pine zone or other zones of montane vegetation. Uneven stocking of isolated peaks in the Chihuahuan Desert province with montane species suggests that long distance transport of propagules, rather than former continuity, may account for the disjunct distributions of many species.

410. Wilson, Andrew IMPACT OF CLIMATE ON INDUSTRIAL GROWTH: TUCSON, ARIZONA: A CASE STUDY In: Sewell, W.R.D. (ed.), Human dimensions of weather modification Chicago, Univ. of Chicago Press, 1966 pp. 249-60, incl. illus., tables, ref. (Chicago, Univ. Dept. of Geography, Res. Paper No. 105, pp. 249-60, 1966) DLC H31.C514 no.105

The climate of Tucson, Arizona is described with the aid of data on precipitation, relative humidity, sunshine duration and atmospheric temperature, and the role of climate in industrial immigration and location in Tucson are considered. The results of a survey indicate that Tucson is regarded as a climatically attractive place to live and that climate has played an important role in attracting manufacturing and other "footloose" economic activities.

411. Axelrod, Daniel I. THE LATE PLEISTOCENE SOBOBA OF SOUTHERN CALIFORNIA Calif., Univ. Pubs. geol. sci., v.60 pp. 1-79, incl. illus., maps, tables, 81 ref., 1966 DLC QE1.C15

The Soboba flora was found on the Idyllwild surface near San Jacinto, south California, in a lakebed deposit in the Bautista formation. It represents an ecotone flora between Bigcone spruce and Yellow Pine forest comparable to that found today 2500' - 3000' above the type-exposure. The Soboba flora is assigned to the Kansas-Nebraskan glacial periods. Comparison with similar present floras indicates an environment in which mean January and July temperatures were 7-9°F lower than at present in the Soboba basin. Annual precipitation totals were 15-20 inches p/a, greater than at present. Disjunct plant communities in southern California indicate the introduction of the Soboba flora from the Sierra Nevada in early Pleistocene times. A post-Wisconsin xerothermic period, in which a Juniper-dominated desert flora spread to the coast of southern California, restricted the Soboba forest to the upper zones of the Coast, Transverse and Peninsular Ranges. A return to more humid, cooler conditions c.3000 years B.P. restricted the xerothermic flora to pockets where a suitable environment was retained. The rapid evolution of plant communities in southern California during the Pleistocene was favoured by: (1) orogenic elevation of the land and the edaphic and climatic variations that resulted from elevation, and the induced erosion and deposition, and (2) climatic variations associated with the major glacial advances.

412. Nord, E.C. AUTOECOLOGY OF BITTERBRUSH IN CALIFORNIA Ecol. monogr., v.35, no.3 pp. 307-34, incl. illus., tables, 65 ref., 1965 DLC QH540.E28

Bitterbrush is an important forage plant and is quite variable in form from sprawling to tree-like, with the larger forms generally at lower elevations. Antelope bitterbrush occurs to the north and desert bitterbrush to the south with hybrids developing where they overlap. Desert bitterbrush is evergreen and sprouts well after burns while antelope bitterbrush is deciduous and is usually destroyed by fire unless moisture is available near the soil surface shortly after the fire. Bitterbrush distinctly prefers deep, coarse textured and well drained soils. Desert bitterbrush can tolerate some lime or saline soil conditions. Seed is produced on the previous year's growth and production is tied to the amount of that growth. Time of ripening correlates with latitude and altitude. Seed dormancy is more rigid in antelope bitterbrush but seedling establishment is much the best in the zone of overlap. Bitterbrush is a vigorous pioneer in primary succession. Heavy browsing especially by sheep is very destructive of bitterbrush. These plants are also subject to insect pests, diseases, and small rodents but the impact of these vectors has not been fully ascertained.

413. Klikoff, Lionel G. MOISTURE STRESS IN A VEGETATIONAL CONTINUUM IN THE SONORAN DESERT Amer. midlands naturalist, v.77, no.1 pp. 128-37, incl. illus., 11 ref., 1967 DLC QH1.A35

The desert vegetation north of Phoenix, Arizona, apparently forms a continuum from open, widely dispersed small shrubs at the lower elevations, c.425 m, relatively dense, tall shrubs at the cooler and moister, higher elevations, c.760 m. With several exceptions, this continuum is correlated with plant moisture stress. Relative turgidity was used as a measure of moisture stress; twigs of 5 different species were collected as soon after sunrise as possible, when moisture stress, whereas small shrubs tend to have sharper fluctuations, probably because of their shallow root systems which are more responsive to brief periods of precipitation. It is suggested that their distribution is at least partly controlled by moisture stress, only small shrubs being able to survive under the more severe conditions.

414. Klikoff, Lionel G. COMPETITIVE RESPONSE TO MOISTURE STRESS OF A WINTER ANNUAL OF THE SONORAN DESERT Amer. midland naturalist, v.75, no.2 pp. 383-91, incl. illus., tables, 4 ref., 1966 DLC QH1.A35

This study of density-dependent aspects of water stress was made in nearly pure stands of Plantago insularis Eastw. var. fastigata (Morris) Jepson in the Sonoran Desert, Arizona, where it had been noted that this plant's frequency varied annually according to precipitation. Five months of observations were made in 3 different plant densities each subjected to 3 degrees of moisture stress, relative turgidity being used as an index. Phenological development, productivity and survival were studied, and genetic variability seemed to influence plant response. No population failed to reproduce although maximum flowering and fruiting were at low moisture stress, and increased moisture stress tended to cause population decline. Earliest flowering and fruiting were at medium moisture stress, although productivity was lowered by medium and high moisture stress.

415. Turner, R.M., S.M. Alcorn, G. Olin and J.A. Booth THE INFLUENCE OF SHADE, SOIL AND WATER ON SAGUARA SEEDING ESTABLISHMENT Bot. gaz., v.127, no.2/3 pp. 95-102, incl. illus., tables, 12 ref., 1966 DLC QK1.B3

The Saguara Carnegiea gigantea, a columnar cactus, is confined to Sonora (Mexico), Arizona, and marginally California. It often forms 'forests' dominating other plants. Small saguaras are seen beneath trees and shrubs but not in the spaces between. The trees and shrubs act as nurse plants. The growth of saguara beneath nurse plants has been explained in terms of moisture and solar radiation, and in terms of rodent damage. Experiments were carried: seedlings were planted on open soil, and beneath nurse plants, but sheltered from rodents. Without shade all the seedlings were dead within a year, on dark hot soils death taking place more rapidly. Survival is possible, apparently, in shade or where water is more freely available. The ratio of moisture storage capacity to the surface area increases as the plant grows so that the plant appears to become independent of the nurse. The effect of toxins from the mesquite is mentioned.

416. Munz, Philip A. CALIFORNIA DESERT WILDFLOWERS Berkeley and Los Angeles, University of California Press, 1962, 122 pp. DLC QK149.M788

The common and scientific names for the desert wildflowers are given along with brief descriptions, illustrations (often in color), and notes on their distribution.

417. Earle, W. Hubert CACTI OF THE SOUTHWEST: ARIZONA, WESTERN NEW MEXICO, SOUTHERN COLORADO, SOUTHERN UTAH, SOUTHERN NEVADA, EASTERN CALIFORNIA Tempe, Ariz., Desert Botanical Garden of Arizona, Science bull. no.4, February 1963, 110 pp., incl. illus. DLC QK147.T45 No. 4

This work provides general information on the origin, distribution, structure, areole, spine, root, flower, and classification of the cacti family. A key to species, as well as descriptions and photographs of the species comprise the bulk of the book.

418. Smith, Ida DESERT BOTANICAL GARDEN Natl. parks mag., 36(173) pp. 9-11, incl. illus., Feb. 1962 SB482.A466

A brief description of the Desert Botanical Garden near Phoenix is given. The Garden houses a museum, research library, herbarium of 3500 specimens, offices, and an auditorium for lectures.

419. Paylore, Patricia ARID-LANDS RESEARCH INSTITUTIONS: A WORLD DIRECTORY Tucson, University of Arizona Press, 1967 268 pp. GB611.P33

More than 200 agencies in 39 countries are described, arranged alphabetically by country under broad continental classes. Information includes name, address, scope of interest, research program, finances, staff and organization, facilities, publications, and history of the institution.

420. IN SPRING DRESS . . . THE ARIZONA DESERT PARK CALLED ORGAN PIPE Sunset, incl. illus., map, March 1961, 38-39+

This tourist-oriented article includes photographs and brief descriptions of the flora of the Sonoran desert; including the organ pipe cactus, Lemaireocereus thurberi, saguaro, Carnegiea gigantea, senita, Lophocereus schottii, and chollas.

421. Arizona University, Office of Arid Lands Studies AN INVENTORY OF GEOGRAPHICAL RESEARCH ON DESERT ENVIRONMENTS Tucson, Ariz. Series eds: William G. McGinnies, Bram J. Goldman, and Patricia Paylore, The inventory was undertaken in cooperation with the US Army, Natick (Mass.) Labs under contract. DA49-092-ARO-71 (Preprint chapters seen; a Univ. of Ariz. Press edition of the entire compendium has been published.

The inventory is comprised of nine chapters; its purpose is to determine in detail what topics have been or are being investigated for the world's deserts, to appraise the reported work, and to disclose areas of study where further work is needed. The series provides a compendium-guidebook to past and present research, and is based upon a critical review of the published literature augmented by consultation with specialists. Geographical areas covered by the inventory were generally those classified as arid or extremely arid by Peveril Meigs in his maps, Distribution of arid homoclimates (UNESCO, 1952). The chapters comprising the inventory are listed below and abstracted separately: (I.) Introduction, by Wm. G. McGinnies and James W. Meadows, Jr.; (II.) Inventory of research on weather and climate of desert environments, by Clayton H. Reitan and Christine R. Green; (III.) Inventory of research on desert coastal zones, by Joseph F. Schreiber, Jr.; (IV.) Inventory of research on geomorphology and surface hydrology of desert environments; by Lawrence K. Lustig; (V.) Inventory of research on surface materials of desert environments, by Harold E. Dregne; (VI.) Inventory of research on vegetation of desert environments, by Wm. G. McGinnies; (VII.) Inventory of research on fauna of desert environments, by Charles H. Lowe; (VIII.) A general summary of the state of research on ground-water hydrology in desert environments, by Eugene S. Simpson; and (IX.) Inventory of research on desert regional types, by John R. Healy.

422. Mitcham, Thomas W. and L. Clark Arnold THE WEST SAN XAVIER MINE, KEYS TO A DISTRICT Ariz. geol. soc. dig., v.7 pp. 147-51, incl. illus., 3 ref., Nov. 1964 DLC unbound

Characteristic of the Pima district, the geology of the West San Xavier mine is very complex. Solution of the complex problems, through detailed studies on this small property, will provide answers applicable to the district -- will supply additional keys to help reconstruct its history. Four propositions are stated that are in need of testing. Also, during the course of elaboration, a number of related problems are suggested.

423. United Nations. Educational, Scientific and Cultrual Organization (UNESCO) DIRECTORY OF INSTITUTIONS ENGAGED IN ARID ZONE RESEARCH Paris, 1953, 110 pp. S1.U5

Ninety institutions are described, arranged by country under broad continental classes. Information includes address, aims, structure, facilities, basic equipment, finances, program, short history and external relations.

424. Kirwiz, John P. THE JERBOA AND THE DESERT Sci. jour., v.1, no.8 pp. 47-51, 8 ref., 1965 DLC unbound

Jerboa Jaculus orientalis, and rats were kept under observation in a laboratory at Alexandria. Their behaviour and physiological patterns in this climate were compared, demonstrating how well the jerboa is adapted to hot desert environment. to combat high temperatures the jerboa burrows and sleeps by day; has a low metabolic rate and low body temperature; and is naturally inactive at high temperatures. The jerboa uses only limited evaporative cooling, in order to conserve moisture. Also to conserve moisture, it rebreathes expried air, excretes only dry products, and stores water and energy in its body efficiently. The jerboa never drinks, and can exist on a diet of dry grains for three years.

425. Harshbarger, John W. and Terah M. Smiley UTILIZATION OF ARID LANDS PROJECT (GENERAL STATEMENT) Ariz. geol. soc. dig., v.3 pp. 111-12, 1960 DLC unbound

Geohydrology and geochronology are significant aspects of a 3-year interdisciplinary study, on "The Utilization of Arid Lands," initiated in June 1958 at the University of Arizona under a grant by the Rockerfeller Foundation. The Gila-San Simon Valley has been chosen for intensive investigation.

426. Schmitt, Harrison A. THE COPPER PROVINCE OF THE SOUTHWEST Min. engrng., v.11, no.6 pp. 597-600, 16 ref., June 1959 DLC TN1.A5258

One of the great Cu-producing areas of the world is comprised of the 5 US western states and northern Sonora, Mexico. The SW province of this area, covering southern Arizona, southwestern New Mexico, and northern Sonora, produces 55% of US Cu output and the equivalent of 15% of world production. In 1956 the area produced about 550,000 tons.

427. Mauger, Richard L., P.E. Damon and B.J. Giletti
ISOTOPIC DATING OF ARIZONA ORE DEPOSIT Amer. Inst. Min.,
Metallurgical, Petrol. Engineers, trans., v.232 pp. 81-87,
22 ref., 1965 DLC TN1.A5

This report includes the lead isotopic dating of a suite of galenas from Arizona and an application of the K-Ar method to the dating of a Laramide porphyry copper deposit, the Silver Bell Mining District. The lead isotopic data supports prior age assignments based upon geologic inference. The Silver Bell study illustrates the necessity of correlative geologic and petrographic investigations for the interpretation of the results of K-Ar dating.

428. Miller, Alden H. and Robert C. Stebbins THE LIVES OF DESERT
ANIMALS IN JOSHUA TREE NATIONAL MONUMENT Berkely, Univ.
of Calif. Press, 1964 452 pp., incl. illus., ref.
DLC QL116.M5

The faunal life of 141 resident vertebrates of the desert is presented. The important characteristics of each animal and how it survives the conditions of a harsh and unyielding environment are discussed. The environments of Joshua Tree Monument in southern California and the solutions of problems of desert life are thoroughly discussed. Faunal analysis in relation to vegetation belts is well-presented in an interesting as well as definitive form.

429. Lowe, Charles H., Jr. BIOTIC COMMUNITIES IN THE SUB-MOGOLLON
REGION OF THE INLAND SOUTHWEST Ariz. acad. sci., jour.,
v.2, no.1 pp. 40-49, incl. illus., table, map, 27 ref.
Aug. 1961 DLC unbound

Five world ecological formation-types are represented in the Sub-Mogollon region, namely, tundra, forest, woodland, grassland and desert. Within the world formation-types there are a number of formations (= biomes) which are arranged with reference to Merriam's life zones in the Inland Southwest. In the Sub-Mogollon region, as elsewhere, the recognizable biotic community, or any natural assemblage of plants and animals of whatever scope (two or more species), can occur at any one point in space and time only as the result of the coincidence of the amplitudes of the genetically controlled ecological tolerances of the comprised species. The nature of the genetic complex is most clearly revealed by the study of plant and animal population distribution over relatively sharp relief. The term Merriam Effect is briefly discussed as well as other environmental factors affecting both vertical and horizontal biotic gradients. Some problems regarding southwestern inter-formational ecotones are also discussed.

430. Wright, Marie L. and Edgar J. Seltzman AN ANNOTATED BIBLIOGRAPHY OF CLIMATIC MAPS FOR MEXICO Rev. ed. US Weather Bur., Rept. no. WB/BM-59, Oct. 1963, 30 pp. AD 660 829 HC \$3.00; MF \$0.65

The eighty-two references listed were drawn from sources in the Weather Bureau Library, the Library of Congress and the US Oceanographic Office Library.

431. Paylore, Patricia SEVENTY-FIVE YEARS OF ARID-LANDS RESEARCH AT THE UNIVERSITY OF ARIZONA. A SELECTIVE BIBLIOGRAPHY, 1891-1965. Tucson, University of Arizona, Office of Arid Lands Research 95 pp., 1966 DLC Z5075.U6A75

This bibliography lists 1171 publications (including theses and dissertations) of the faculty and staff of the University of Arizona dealing with arid lands subjects. The arrangement is chronological within broad subject categories, which include the following relevant to the desert environment bibliography; geochronology and geology, atmospheric environment, soils and fertilizers, native vegetation, wildlife and wilderness studies, and environmental studies.

432. Wells, P.V. and R. Berger LATE PLEISTOCENE HISTORY OF CONIFEROUS WOODLAND IN THE MOHAVE DESERT Science, v.155, no.3770 pp. 1640-47, incl. illus., 26 ref., 1967 DLC Q1.S35

Seventeen ancient wood-rat middens ranging in radiocarbon age from 7,400 - 19,500 years and to older than 40,000 years B.P. have been uncovered in various sectors of the Mohave Desert. These show that the boundary between various types of vegetation has shifted quite dramatically. Xerophilous juniper woodland for example, descended to an elevation of 1100 metres (600 metres below the present lower limit) in the north eastern part of the desert between 9,000 and 10,000 years ago. Desert species often appear to have coexisted with woodland trees in the same areas however, and there was distinct time period before vegetation became adjusted to changing climatic conditions.

433. Quiroz, Roderick S. RECORD SNOWFALL IN SUNNY SOUTHERN ARIZONA
Weatherwise, v.12, no.2 pp. 49-50, 2 ref., April 1959
DLC QC851.W42

On November 16, 1958, the heaviest snowfall ever recorded in Tucson, Arizona since records began in 1897, and the first ever recorded in November, occurred. Snow fell all over Arizona that day. Damage to crops was not great. Trees were broken in Tucson and cotton harvest was retarded. A contingency table shows frequency of 24-hour snow amounts at Tucson (1931-1958) in different class intervals. Maximum of 6.4 inches exceeds previous maximum of 3.5 inches on January 25, 1949. Surface synoptic conditions are quite varied but 500-mb conditions are more uniform. A closed center low and temperatures of less than -30° at Tucson up to 48 hours before snow began. This proved to be a necessary but not a sufficient condition for snow at Tucson.

434. Kassander, A. Richard, Lee L. Sims and James E. McDonald
OBSERVATIONS OF FREEZING NUCLEI OVER THE SOUTHWESTERN
UNITED STATES Arizona, Univ. Inst. Atmos. Phys., Sci.
rept. no. 3, Nov. 1, 1956 18 pp., 3 ref.

The results of daily flights in Jan. 1955 in the vicinity of Tucson, Arizona for the purpose of detecting natural freezing nuclei are presented. Samples were taken each day at 15,000 ft., 5,000 ft. and at the surface. No systematic correlation was noted with the long-term total rainfall record according to the Bowen meteoric dust hypothesis. However, the fact that average temperatures for given concentrations over Sydney, Australia is noted. Certain interesting observations on natural ice crystal clouds are also discussed.

435. Balchin, W.G.V. and Norman Pye CLIMATE AND CULTURE IN SOUTHERN ARIZONA Weather, v.10, no.12 pp. 399-404, 2 ref.
Dec. 1955 DLC QC851.W4

A general account of the hot dry sunny climate of southern Arizona and the adaptations of life to it. Cooling methods in houses, trains and autos, air conditioning, refrigeration, clothing and pattern of living are briefly described.

436. Battan, Louis J. RELATIONSHIP BETWEEN CLOUD BASE AND INITIAL RADAR ECHO Jour. appl. meteorol., v.2, no.3 pp. 333-36, 8 ref., June 1963 DLC QC851.A66

The altitudes of the average initial precipitation echoes in convective clouds in Arizona for particular days have been compared with the altitudes of the calculated cloud base. They are found to be positively correlated. The implication of this result is that the dominant precipitation initiation mechanism in convective clouds in southern Arizona is the coalescence process.

437. Instituto Mexicano de Recursos Renovables, Mexico, D.F.
ROUND TABLE ON PROBLEMS OF ARID ZONES IN MEXICO, HELD AT
THE CENTRAL LIBRARY OF THE CIUDAD UNIVERSITARIA, JANUARY
24-28, 1955 (Mesas redondas sobre problemas de las zonas
aridas de Mexico, Biblioteca Central de la Ciudad Univers-
itaria, 24-28, enero, 1955.) Mexico, D.F., 1955, 262 pp.
(In Spanish) DWB

Contents:

Contreras Arias, Alfonso: (Definition of the arid zones
and their limits in Mexico), pp. 1-40;
Garcia Quintero, Andres: (Hydrology of the arid zones of
Mexico), pp. 41-83;
Miranda, Faustino: (Forms of vegetable life and the prob-
lem of the limits of the arid zones of Mexico), pp. 83-123;
Gonzalez Cosio, Manuel: (Observations and projects in the
arid zones of Mexico), pp. 125-175;
Hernandez Corzo, Rodolfo: (Problems of the industrializa-
tion of the products of the arid zones of Mexico), pp. 177-
234;
Beltran, Enrique: (Mexico and its arid zones: problems
and prospects), pp. 235-262.

The first round table under the guidance of Contreras Arias
contains a discussion of the distribution of arid and semi-
arid zones over the world and in Mexico, in particular of
the meteorological factors which cause aridity and semi-
aridity especially those characteristics of the atmospheric
circulations over Mexico and adjoining regions, and quanti-
tative methods of expressing the humidity or aridity of a
region. Thornthwaite's climate classification is described
and it is applied to a classification of the moisture regime
of Mexico. Maps showing the distribution of potential evap-
otranspiration and moisture conditions in Mexico and a graph
showing the observed and calculated evapotranspiration by
the formulas of Thornthwaite, Taber, McCloud-Dunovan and
Blaney and Criddle are included. Discussion on the hydrol-
ogy of the arid zones of Mexico by Garcia Quintero includes
a discussion of the location of the arid zones in Mexico,
their topography, the rainfall, characteristics, coeffic-
ients or surface drainage and irrigation. Each principal
topic is accompanied by an extensive discussion.

438. Hastings, James Rodney and Stanley M. Alcorn PHYSICAL DETERMINATIONS OF GROWTH AND AGE IN THE GIANT CACTUS Ariz. Acad. Sci., Jour., v.2, no.1 pp. 32-39, 6 ref., August 1961 DLC PRR

Study on the bacterial necrosis of the giant cactus or saguaro (*Carnegiea gigantea*) was aimed at deriving a growth curve with some degree of confidence. During the period 1951-1960, 1115 annual growth increments were distributed among height classes with 2-ft intervals. Mean growth rate, standard deviation and the standard error of the mean were computed for each class. Using estimated curve and manually summing annual growth increments, the height-age relation was obtained. A comparison with the height-age equivalents formulated by Shreve graphically represented a difference which was regarded due to the production of the branches. After analyzing by height class, analysis by year was tabulated. Maximum mean growth (4.04") occurred during 1951-1952 and minimum mean growth (1.77") during 1956-1957. The mean for the entire period, 1951-1960 amounted to 2.64" per year. Hasting's hypothesis that average annual growth reflects the amount of precipitation received during the summer rainy season needs verification.

439. Egler, Frank E. FORREST SHREVE AND THE SONORAN DESERT Geogr. rev., v.44, no.1 pp. 137-41, January 1954 DLC G1.G35

This article provides a posthumous review of the geographical and botanical work of Forrest Shreve, and especially of his classic work on the Vegetation of the Sonoran Desert.

440. Fries, Carl Jr. LIST OF GEOCHEMICAL DATES REPORTED FOR MEXICAN MINERALS AND ROCKS, WITH COMMENTS ON THEIR GEOLOGIC AND GEOTECTONIC SIGNIFICANCE (Lista de fechas geoquimicas reportadas' para minerales y rocas mexicanas, con un comentario sobre su significado geologico y teotectonico.) Text in Spanish Mexico (City), Univ. nac., Inst. geol., bol. 64, pt. 6, pp/ 85-109, 36 ref., 1962 DLC QE201.A2 no. 64

Excluding radiocarbon ages, some 35 isotopic age determinations have been made on rocks from southern Chiapas to northern Baja California. Fifteen were obtained by the lead-alpha method, 13 by K-Ar, 5 by Rb-Sr and 2 by U-Pb. Ages range from 26 to 1710 m.y., and most accord well with those judged from field work; a few are discrepant, and others are entirely new. In spite of their limited number, the isotopic ages register several main geotectonic events.

441. Damon, Paul E. et al AGE OF THE OLDER PRECAMBRIAN AND OTHER BASEMENT ROCKS OF THE CABORCA-ALTAR REGION OF NORTHWESTERN SONORA (Edad del precambrico "anterior" y de otras rocas del zocalo de la region de Caborca-Altar de la parte noroccidental del estado de Sonora) Text in Spanish Mexico (City), Univ. nac., Inst. geol., bol. 64, pt.2 pp. 11-44, incl. illus., tables, 21 ref., 1962 DLC QE201.A2 no.64

Geochemical ages, lithology, and structural trends of the Precambrian metamorphic rocks of this region are like those of the Older Precambrian of Arizona and justify their correlation with the Older Precambrian System of southwestern U.S. At Bamori the Older Precambrian is metamorphosed to horn-Blende-hornfels facies. These rocks form a NE-trending anticline, show retrogressive metamorphism, and are intruded by diabase and lamprophyry dikes and sills. They are truncated and covered by a distinctive basal conglomerate, which can be recognized as far as Cerros del Arpa, where an arkosic regolith appears on a red granite with graphic texture, called the Aibo Granite. This granite is similar to the batholithic granites of the final phases of the Mazatzai Orogeny of the Older Precambrian of Arizona. It is cut by a quartz monzonite body of Santa Lucian age (85± m.y.). Geochemical ages indicate more than 1680 m.y. for the Older Precambrian sedimentation. Younger Precambrian sediments covering the basal conglomerate are mainly of marine origin and resemble those of the Younger Precambrian System of southwestern US. In both regions these sediments are little metamorphosed, little deformed, and may be correlated, although it must be remembered that the Younger Precambrian System covers an interval equal to the entire Phanerozoic Eon. The Altat Schist in Cerros del Carnero could not have been derived from the Paleozoic rocks, but possibly from the Mesozoic or Precambrian rocks. Geochemical ages, however, show that the Altar Schist was affected by a Laramide thermal event.

442. Goldman, Edward Alphonso BIOLOGICAL INVESTIGATIONS IN MEXICO
Wash., Smithsonian Institution, publication 4017, Smith.
misc. coll., v.115, 476 pp., incl illus., map, 1951
DLC

The results of the biological explorations made by E.W. Nelson and E.A. Goldman in Mexico from 1892 to 1906. Results include not only the collecting of 17,400 mammal specimens, 12,400 birds, many reptiles and amphibians, more than 10,000 plants, and other biological items, but also a vast fund of information obtained and preserved in thousands of pages of manuscript reports in regard to the physiographic features, fauna, and flora of the country. Mammal collections contained 354 spp. and subspp. described as new. Prefatory note by abstracter and author's Introduction give a brief history of the project. "Itinerary of Nelson and Goldman in Mexico and Guatemala, 1892 to 1906" covers 30 pp. 263 pages are devoted to the important section "Localities visited by Nelson and Goldman in Mexico and Guatemala, 1892-1906," which gives the states alphabetically and under each state localities visited similarly arranged. Altitude where known is given for each locality, and the inclusive dates of visitation there, followed by a brief description of the location with special reference to physiographic and biologic features. There are 570 localities listed, 83 of which are cross references; Baja California leads with 90, Oaxaca has 72. A section on physiography discusses general features, the tableland or great interior plateau, mountain ranges, plains, drainage, and climate. Under biotic relations both life zones and biotic provinces are treated. Eight life zones are recognized as occurring in Mexico, namely, Lower Tropical, Upper Tropical, Lower Austral, Upper Austral, Transition, Canadian, Hudsonian, and Arctic Alpine, and lists of representative spp. of plants, mammals, and birds are included under each zone. There are 18 biotic provinces in Mexico, designated as California (San Diegan and San Pedro Martir biotic districts), Guadalupe Island, Vizcaino Desert (Colorado Desert), Central Baja California (Sierra de la Giganta and Cape Districts), Revillagigedo, Sonora (Yuma Desert, Yaqui, Tiburon Island, and Mayo districts), Sierra Madre Occidental, Chihuahua-Zacatecas (Chihuahua-Coahuila and Central Tableland districts), Tamaulipas, Sinaloa, Nayarit-Guerrero, Sierra Madre Oriental, Transverse Volcanic, Veracruz, Sierra del Sur, Tehuantepec, Chiapas Highlands, and Yucatan Peninsula. A bibliography of 9 titles is given. There are 138 halftones in 71 plates. A folding map 22 by 16 inches clearly and concisely indicates the routes of Nelson and Goldman, and locates all localities in the gazetteer. The index contains about 3,000 entries.

- 443 Noris, K.S. THE HABITAS OF THE FLAT-TAILED HORNED LIZARD,
PHRYNOSOMA M'CALLII Copeia, 1949, no. 3 176-180 pp.,
incl. illus., 1949 DLC QL1.C65

Observations of P. m'callii in the Coachella Valley of California show that it is primarily an arenicolous form. Numerous adaptations to sand-dwelling existence include a dorso-ventrally flattened body and tail, scalation changes facilitating rapid burial in the sand, and remarkable protective coloration. A modified form of sand swimming was observed. The opt. activity temp. range was found to be from 35°C to 41°C. Temperature control mechanisms are discussed. Heavy nematode infestation was noted in stomach analysis and seems to be correlated with the animals' strict diet of ants.

444. Hensley, H.M. ECOLOGICAL RELATIONS OF THE BREEDING BIRD POPULATION OF THE DESERT BIOME OF ARIZONA Ecol. monogr., v.24, no.2 pp. 185-207, incl. tables, graphs, map, 30 ref., April 1954 DLC QH540.E28

Four areas exhibiting typical lower Sonoran desert vegetation were studied in Organ Pipe Cactus National Monument. Of these, 2 represented wash situations and 2 were located in intermountain plains. A total of 295 transient individuals, representing 18 spp. were observed on 2 wash areas while 165 individuals of 7 spp. traversed inter-wash plots. Breeding population was lower in open desert where 37 prs. per 100 ac. in 2 wash areas. A total of 294 eggs were laid of which 235 hatched and 214 fledged from 102 nests. Expressed in percentages, 80% of eggs laid hatched, 72% fledged, 91% of young hatched fledged, and 70% of nests were successful. White-winged and mourning doves exhibited lowest nest success being 42% and 50% respectively.

445. Went, F.W. and M. Westergaard ECOLOGY OF DESERT PLANTS III. DEVELOPMENT OF PLANTS IN THE DEATH VALLEY NATIONAL MONUMENT, CALIFORNIA Ecology, v.30, no.1 pp. 26-38, 1949 DLC QH540.E3

Observations on germination and growth of plants in the Death Valley region (California) show a correlation between amt. of rainfall and temps. immediately following the rain, and the spp. of plants germinating and developing. A rain followed by 30°C minimal temps. resulted in no germination (there is no summer annual vegetation); followed by 15-16°C minimal temps., a rain caused only germination of Larrea, but followed by 8-10°C minimal temps. full germination of winter annuals occurred, with no Larrea. Some differences in the floristic composition of the winter-annual flora were found, especially according to salinity of soil, and altitude. In general the Valley Bottom had the smallest number of plants growing, and this number increased with increased altitude. In a few greenhouse expts. it was found that best germination of the seeds in Death Valley soil occurred at 18° phototemperature and 13° nyctotemperature.

446. Smith, Hobart M. HERPETOGENY IN MEXICO AND GUATEMALA Assoc. Amer. geographers, ann., v.39, no.3 pp. 219-38, 1949 DLC G3.A7

A map of the biotic regions and subregions of Mexico is given. For each subregion some of its characteristics are given. Some conclusions are: the fossil record of these groups here is of little assistance; the plateaus are populated preponderantly by primitive species; reptilian differentiation is slower than mammalian; the Panamanian oceanic portal was probably closed in the late Oligocene or early Miocene; the fauna developed during alternating dispersal and regression stages, of which three occurred in this region; three significant stages are Cul-de-Sac, Isolation and Montane; mountain masses served as primary centers of dispersal and refuge; Mexico and Guatemala were primary centers of dispersal. The 31 biotic provinces are grouped into six subregions: Sierran (5 provinces), Sonoran (7), California (1), Pacific (5), Atlantic (7), and Guatemalan (6). The life zone concept is fundamental. The greater the continuous horizontal range of a life zone the less the vertical range of the biotic area.

447. Lowe, Charles H., Jr. THE EASTERN LIMIT OF THE SONORAN DESERT IN THE UNITED STATES WITH ADDITIONS TO THE KNOWN HERPETO-FAUNA OF NEW MEXICO Ecology, v.36, no.2 pp. 343-45, 1955 DLC QH540.E3

The known distributions of genera, species, and subspecies of cold-blooded vertebrates, warm-blooded vertebrates, and of plants, are in agreement in indicating the eastern limit of the Sonoran Desert in the US to lie in southwestern New Mexico in the approximate position of the eastern limit of the Colorado River basin at that latitude.

448. Miller, Halsey W., Jr. CRETACEOUS DINOSAURIAN REMAINS FROM SOUTHERN ARIZONA Jour. paleontol., v.38, no.2 pp. 378-84, incl. illus., 9 ref., March 1964 DLC QE701.J6

Lower Cretaceous sediments contain remains of stegosaurs and iguanodontids. Upper Cretaceous rocks contain hadrosaurs, theropods, and non-dinosaurian vertebrates such as trionychid turtles, garpike, amloid and elopid fish.

449. Stuiver, Minze CARBON ISOTOPIC DISTRIBUTION AND CORRELATED CHRONOLOGY OF SEARLES LAKE SEDIMENTS Amer. jour. sci. v.262, no.3 pp. 377-92, incl. illus., tables, 12 ref., March 1964 DLC Q1.A5

The present study of Searles Lake sediments is a continuation of previous work summarized by Flint and Gale in 1958. The more detailed analysis of the strata indicates that pluvial conditions in the southeastern part of California ended around 10,200 years ago when the main part of the water body of the lake evaporated rapidly within a few hundred years. The pluvial period itself must have been rather long and probably started after the termination of the dry period connected with the last major interglacial period, the only interruption being 24-33 thousand years ago when 5 short warm and dry intervals are indicated. Post-depositional diffusion of carbonates in the sediments is discussed as a possible explanation of small discrepancies found¹³ between organic and carbonate ages. The new data on C¹³ isotopic ratios do not show any systematic trend with depth or layer.

450. Sutherland, Mason SONORA IS JUMPING Natl. geogr. mag., v.107,
no.2 pp. 215-46, incl. illus., map, Feb. 1955
DLC G1.N27

The major part of this popular-type article describes the industrial and agricultural development, schools, local history and culture, and mining legends. A good map of the west coast of Mexico in which some physiographic as well as geographic locations is provided. Several of the photographs indicate desert landforms and flora.

451. Wishaw, Quentin G. PROSPECTING FOR PORPHYRY-TYPE COPPER DE-
POSITS IN ARIZONA Can. mining jour., v.84, no.4 pp. 67-69,
April 1963 DLC TN1.C3

A summary of the geology of Arizona porphyry Cu deposits is given. Comments are included on mineralogy, petrologic associations, alteration, enrichment, capping, oxidation, zoning, and structure. Recent prospecting on the Papago Indian Reservation is reported upon with special mention of techniques employed in color serial photography, geologic mapping, geochemistry, and geophysics.

452. Pierce, W. Dwight THE SIGNIFICANCE OF THE PETROLIFEROUS NODULES
OF OUR DESERT MOUNTAINS So. Calif. Acad. Sci., bull.,
v.61, pt.1 pp. 7-14, Jan.-March 1962 DLC Q11.S85

Petroliferous nodules containing Miocene fossils occur in desert areas of California and all have in common that they are in association with sources of B and andesitic volcanos. The fossils include 26 orders of invertebrates (principally insects), 2 fish skeletons, bird feathers, mammal hairs, diatoms, algae, mosses, pond weeds, and seeds of higher plants. Rapid kill and preservation is indicated. The biologic material is now silicate or strontium celestite. The role of B as a catalyst in the formation of petroleum is suggested.

453. Thomas, Robert G. THE LATE PLEISTOCENE 150 FOOT FRESH WATER BEACH LINE OF THE SALTON SEA AREA So. Calif. Acad. Sci., bull., v.62, pt.1 pp. 9-17, Jan.-March 1963, 13 ref.
DLC Q11.S85

Deeply weathered, poorly preserved beach deposits with fresh water fossils are found in the Salton Sea region west of El Centro, California, at an elevation of about 150 feet. This shoreline was probably formed during the Sangamon interglacial stage when world wide sea level was higher than at present. The high sea level had caused the Colorado River to build up an ancient delta about 100 feet higher than the present Colorado River Delta. During Wisconsin time sea levels lowered to 300 or 400 feet below present levels causing the Colorado River to remove much of this ancient delta and possibly allowed the Whitewater River to reach the Gulf. As sea levels rose in post-Wisconsin time, the present delta has been built up. The well preserved 40 foot fresh-water beach line was formed only a few hundred years ago.

454. Tasch, Paul and Bernard L. Shaffer CONCHOSTRACANS: LIVING AND FOSSIL FROM CHIHUAHUA AND SONORA, MEXICO Science, v.143, no.3608 pp. 806-07, Feb. 21, 1964, 17 ref.
DLC Q1.S35

In August 1963, living conchostracans (branchiopod Crustacea) of the general Leptestheria and Eulimnadia were collected at 3 stations in Chihuahua. One Sonoran locality yielded Triassic fossils of the family Cyzicidae, a wide-spread North American group. The geographic range of the geologically younger families Leptestheriidae and Limnadiidae (particularly of the genus Eulimnadia) thus extended to Chihuahua during post-Mesozoic time.

455. Williams, Sidney A. OXIDATION OF SULFIDE ORES IN THE MILDREN AND STEPPE MINING DISTRICTS, PIMA COUNTY, ARIZONA Econ. geol., v.58, no.7 pp. 1119-25, incl. tables, 14 ref., November 1963 DLC QE1.E15

Oxidation of sulfide ores in the Mildren and Steppe mining districts has yielded a wealth of supergene and mesogene minerals. The observed paragenetic sequence for supergene minerals in all instances follows the same pattern and, if the paragenesis is interpreted in the light of Eh-pH diagrams,

it can be seen that oxidation began in highly acid waters and proceeded with continually increasing basicity and Eh. It is also evident that ions released in reactions must have been carried off by ground water. Many elements are found in the supergene minerals although relatively few occur in the hypogene ores. This is taken as evidence that some of the elements were effectively leached from the wall rocks.

456. Moore, Robert and Halsey W. Miller Jr. A DINOSAUR-BEARING SECTION OF CRETACEOUS ROCKS IN THE EMPIRE MOUNTAINS, PIMA COUNTY, ARIZONA Ariz. geol. soc., digest, v.3 pp. 57-61, incl. fig., 3 ref., 1960 DLC unbound

The complete right femur and fragments of the left femur of a tentatively designated Upper Cretaceous hadrosaur are described. They were found in mainly nonmarine shales and sandstones near Empire Mountain 40 mi. SE of Tucson, Arizona. A partial stratigraphic section is given.

457. Lance, John F. STRATIGRAPHIC AND STRUCTURAL POSITION OF CENOZOIC FOSSIL LOCALITIES IN ARIZONA Ariz. geol. soc., dig., v.3 pp. 155-59, incl fig., 11 ref., 1960 DLC unbound

The discovery of several new fossil localities in Arizona during the last 10 years warrants the development of an outline of Cenozoic history which may be useful as a guide for further work. In southern Arizona almost continuous orogeny lasted from late Cretaceous to Miocene. The central mountainous area was uplifted from early Miocene to early Pliocene. Volcanic activity was intermittent. The major drainageways were developed after the Laramide uplift. Disruption of southwesterly drainage from the Plateau region, cutting of gorges, and formation of basin-and-range topography were largely Miocene events. Pliocene structural movement, volcanic activity, and diversion of waters resulted in complex changes of the drainage pattern. Sedimentation in some valleys of E-central and southeastern Arizona continued until mid-Pleistocene. Alluvial fans and pediment gravels covered fine-grained Pliocene and lower Pleistocene beds during middle and late Pleistocene.

458. Bogusch, E.R. CLIMATIC LIMITS AFFECTING DISTRIBUTION OF MESQUITE (Prosopis juliflora) Texas jour. sci., v.3, no.4 pp. 554-58, 1951 DLC Q1.T4

Studies on the past and present distribution of mesquite and its varieties indicate that its limit of spread are effectively set by climatic factors. The extent, nature and problems of mesquite in western and south central Texas are examined, particularly along the Rio Grande and in the Big

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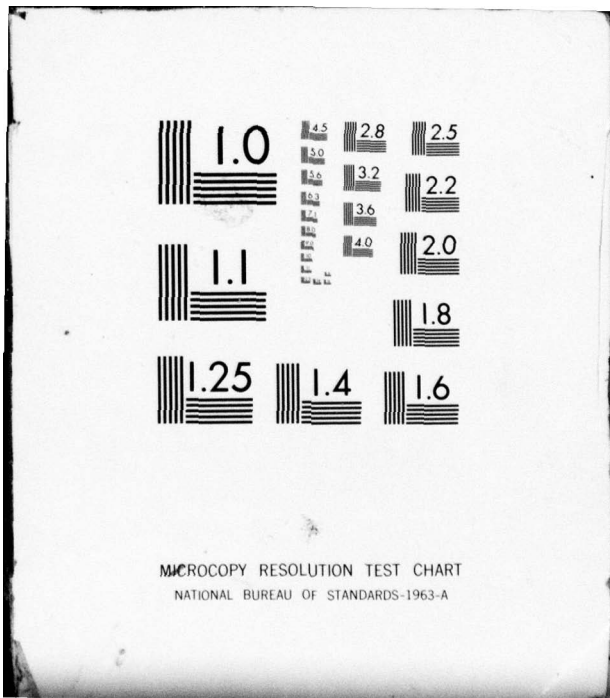
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Bend country. This paper is helpful in that that which is applicable on the north side of the Rio Grande also applies to the northern portions of the Sonoran Desert.

459. Williams, Sidney A. A NEW OCCURRENCE OF ALLANITE IN THE QUIJOTOA MOUNTAINS, PIMA COUNTY, ARIZONA Ariz. geol. soc., digest, v.3 pp. 47-51, incl. map, tables, ref., 1960
DLC unbound

Allanite was discovered in the east flank of the Quijotoa Mountains, 2 miles south of Covered Wells. The deposit, of no economic significance, occurs as a roughly N-S zone cutting through quartz monzonite. The north end of the deposit disappears in a spessartite intrusion which also cuts the quartz monzonite. The south end of the zone was not defined, although it was traced for about 2 miles along the strike. Allanite is highly concentrated as disseminations and pods in the northernmost 100 yards of the zone. Petrographic and mineralogic relations are given.

460. Huff, Lyman C. and A.P. Marranzino GEOCHEMICAL PROSPECTING FOR COPPER DEPOSITS HIDDEN BENEATH ALLUVIUM IN THE PIMA DISTRICT, ARIZONA US Geol. Survey, Prof. paper 424-B, pp. 308-10, 1961, 3 ref. DLC QE75.P9

Geochemical studies of Cu-Mo deposits in the Pima mining district near Tucson indicate that analysis of ground water, of phreatophytic plants, and of a carbonate-cemented zone at the base of the alluvium may be useful in prospecting for similar deposits hidden beneath alluvium.

461. Kurtz, Edwin B. and Stanlye M. Alcorn SOME GERMINATION REQUIREMENTS OF SAGUARO CACTUS SEEDS Cactus and succulent jour., v.32, no.3 pp. 72-74, 1960

Germination is stimulated by red light and inhibited by far-red; in alternate stimulation the last light applied determines germination was reached after inhibiting period of 24 hours following $\frac{1}{2}$ hour exposure to red. Two, 3 or 4 exposures to red increased germination, 4 exposures producing results obtained in room conditions in light. At constant temperature, germination is best between 68° and 86°F, or with fluctuating temperature, from 59° to 95°F.

462. Cruise, Robert R. A CHEMURGICAL SURVEY OF THE DESERT FLORA
IN THE AMERICAN SOUTHWEST Econ. bot., v.3, no.2
pp. 111-31, 1948 SBl.E3

Commercial utilization of the desert flora consists of the possibilities of obtaining stock feed, alcohol, paper pulp, sugars, starches, resins, gums, alkaloids, oils, and other extracts from the xerophytic plants of the Southwest.

463. Wasserburg, G.J. and Marvin A. Lanphere AGE DETERMINATIONS
IN THE PRECAMBRIAN OF ARIZONA AND NEVADA Geol. soc. Amer.,
bull., v.76, no.7 pp. 735-58, incl. illus., tables, July
1965, 48 ref. DLC QE1.G2

Sr⁸⁷-Rb⁸⁷ and Ar⁴⁰-K⁴⁰ ages were determined from samples of Precambrian rocks from western Arizona, southern Nevada, and southwestern Utah. These and similar ages measured by other workers from rocks of a geographically contiguous region of California, Nevada, and Arizona and from widely distributed localities in Utah, Arizona, and Sonora, Mexico, indicate that the older Precambrian basement throughout the far southwestern US was involved in an episode of metamorphism and plutonism 1600-1800 m.y. ago. Well-documented ages of 1350-1450 m.y. are not as extensive as previously thought. An isolated pluton that has an age of 1060 m.y. intruded the older metamorphic terrane in southern Nevada, which indicates that some of the plutonism in the far southwestern US is later Precambrian.

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64. Stewart, L.A. and A. J. Pfister BARITE DEPOSITS OF ARIZONA
US Bur. Mines, Rept. inv. 5651, 89 pp., 1960 DLC TN23.U43
no. 5651

This paper describes all occurrences of barite in Arizona that were known or reported. The history, ownership, production, and geologic setting are discussed for most of the deposits. More than half of the article is devoted to mines in Yuma and Pima Counties.

465. Gray, Jane EARLY PLEISTOCENE PALEOCLIMATIC RECORD FROM SON-
ORAN DESERT, ARIZONA Science, v.133, no.3445 pp. 38-9,
incl. table, 7 ref., Jan. 6, 1961 DLC Q1.S35

Three pollen spectra from lake sediments stratigraphically well below mid-Kansan fauna indicate plant associations for the Sonoran Desert, approximating those found now at elevations of 1,500 feet and more above the desert floor. The presence of Ostrya, Betula, and Artemisia may indicate some invasion by northern species as well. A climate cooler

or wetter, or both cooler and wetter, than the present climate is inferred from paleo-botanical and sedimentary evidence. Correlation with the Nebraskan glacial stage is tentatively suggested.

466. Cutak, Ladislaus CACTUS GUIDE Princeton, N.J., Van Nostrand, 1956, 144 pp., incl. illus., ref. DLC SB413.C12C8

Aimed at the general reader, this book discusses the varieties of cacti, their care, diseases, propagation and uses.

467. Busby, C.E. SOME LEGAL ASPECTS OF SEDIMENTATION Amer. soc. civ. engineers, hydraul. div., jour., v.87, no.HY4 pp. 151-80, incl maps, 60 ref., July 1961 DLC TC1.A39

Legal aspects of sedimentation, of interest to the engineer, geologist, and soil scientist, are presented. The paper concerns rights in land, as deposited sediment and rights to water, as containing or transporting sediment. It also contains the rights to be free from undue damage caused by artificial changes in the movement and effects of water, involving sedimentation as a process.

468. Heindl, L.A. and Oliver J. Cosner HYDROLOGICAL DATA AND DRILLERS' LOGS, PAPAGO INDIAN RESERVATION, ARIZONA Ariz. State Land Dept., Water res. rept., no.9 116 pp., incl. tables, map, 10 ref., 1961

The tables in this report summarize the basic well data, drillers' logs, and chemical analyses of well water collected by the US Geological Survey on the Papago Indian Reservation during an investigation of the geology and ground-water resources of the reservation. The investigation was made at the request of the Bureau of Indian Affairs as part of the general Papago rehabilitation program. The tables were compiled to provide a ready reference to information about individual wells and specific locations not included in the general report on the ground-water conditions on the Papago Indian Reservation. These tables contain much of the basic data used in the preparation of the general report which will be issued at a later date as a US Geological Survey water-supply paper. Information about other wells and those drilled after the completion of this study is available in the open files of the US Geological Survey Ground Water Branch Offices in Tucson and Phoenix, Arizona. Basic data from the smaller San Xavier and Gila Bend Indian Reservations, the other 2 parts of the 3 Papago reservations, are few and will be included with the general reports on those areas.

469. Bloom, Harold GEOCHEMICAL EXPLORATION AS APPLIED TO COPPER-MOLYBDENUM DEPOSITS In Geology of the porphyry copper deposits, southwestern North America Tucson, Univ. of Ariz. Press, 1966 pp. 111-19, incl. illus., tables, ref. DLC QE79.5.T55

Geochemical prospecting for porphyry copper-molybdenum deposits has been done on soils, waters and vegetation in the southwestern United States. The average distribution of molybdenum is discussed. Since rhenium is associated with molybdenite in the copper deposits, its geochemistry and mobility are included. Descriptions are given of primary and secondary halos.

470. Schmitt, Harrison A. THE PORPHYRY COPPER DEPOSITS IN THEIR REGIONAL SETTING In Geology of the porphyry copper deposits, southwestern North America Tucson, Univ. of Ariz. Press, 1966, pp. 17-33, incl. illus., ref. DLC QE79.5.T55

The principal structural elements of the Southwest are described in detail, and their relation to the sedimentation, erosional history, and igneous activity, are discussed. The principal systems of deformation are: the older Precambrian northeast system, the meridional system, and the west to west-northwest transverse system. Continental and intercontinental considerations of such structures as the Texas zone and Menard's East Pacific Rise, are given. Ore deposits are associated with major fault zones, orogens, tectogenes, and especially their intersections. Most of the great copper deposits occur along the Wasatch-Jerome orogen, particularly at its intersection with the Texas zone. Discussion by H.W. Menard and H.H. Schmitt, with the author's replies, is included.

471. Cole, Gerald A. and Melbourne C. Whiteside AN ECOLOGICAL RECONNAISSANCE OF QUITOBAQUITO SPRING, ARIZONA Ariz. Acad. Sci., Jour., v.3, no.3 pp. 159-63, incl. tables, 17 ref., April 1965 DLC PRR

Recent investigations of Quitobaquito Spring, an important water hole along the old Camino del Diablo and now a part of Organ Pipe Cactus National Monument, are described and discussed. Physioco-chemical features of the waters, the aquatic macrophytes, vertebrate animals, biota of the ditches along which the spring flows into the pond, plankton, bottom fauna and swimming insects, and primary productivity were investigated.

472. Kinnison, John E. THE MISSION COPPER DEPOSIT In Geology of the porphyry copper deposits, Southwestern North America, ed. by S.R. Titley and C.L. Hicks Tucson, Univ. of Ariz. Press, 1966 pp. 281-87, incl. illus., ref.
DLC QE 79.5.T55

Bedrock surface, in the Mission mine area near Tucson, is a buried pediment, and only a few small outcrops protrude. Hypogene sulfides are within 50 feet below the bedrock surface, with only a very thin veneer of secondary enrichment, the process of pedimentation having removed the original blanket. Alteration is pervasive in the deposit, and sulfides are disseminated in all rocks in the altered zone. The monzonite porphyry has no specific spatial relation to ore or alteration but probably has an indirect genetic relation to mineralization.

473. Lynch, Dean W. THE ECONOMIC GEOLOGY OF THE ESPERANZA MINE AND VICINITY In Geology of the porphyry copper deposits, Southwestern North America, S.R. Titley and C.L. Hicks (eds) Tucson, Univ. of Arizona Press, 1966, pp. 267-79, incl. illus., ref. DLC QE79.5.T55

The Esperanza copper-molybdenum deposit is in the Pima district, Arizona. Rock types described from the area are welded tuffs, four types of porphyry, granodiorite, and quartz diorite. The igneous rocks were intruded and extruded in a number of individual pulses. All rock types contain sulfides in varying amounts. Strong hydrothermal alteration persisted throughout the area, and potash metasomatism is a distinctive feature. The most prominent structural features are faults, which acted as conduits for ascending hypogene solutions and descending enriched solutions.

474. Cooper, John R. TURKEY-TRACK PORPHYRY -- A POSSIBLE GUIDE FOR CORRELATION OF MIOCENE ROCKS IN SOUTHEASTERN ARIZONA
Ariz. geol. soc. dig., v.4 pp. 17-33, incl. tables, 16
ref., Nov. 1961 DLC unbound

The turkey-track porphyry has the same macroscopic characteristics including a somewhat unusual and very distinctive texture. Two chemically analyzed specimens from widely separated localities are both doreites, a fairly uncommon rock type. The analyzed specimen from the Klondyke quadrangle is a plagioclase-olivine-augite porphyry, very low in iron and magnesium and very high in alkalis, for a doreite. Specimens from the Dragoon quadrangle are petrographically the same as those from the Twin Buttes quadrangle and have at least some of the same queer chemical characteristics. Seven spectrographic analyses indicate that the trace-element content of the rock from the Klondyke, Twin Buttes, and Dragoon quadrangles is practically the same. The geologic occurrence of turkey-track porphyry flows, particularly their local intercalation with other kinds of rock, shows that eruptions were repeated and must have been spread out over a long span of time, as most people view it. Nevertheless, the indicated span of time at any one locality was short geologically. Rough contemporaneity of turkey-track porphyry eruptions is suggested by stratigraphic relations in the Twin Buttes, San Xavier Indian Reservation, and Cienega Gap areas.

475. Mielke, James E. TRACE-ELEMENT INVESTIGATION OF THE "TURKEY TRACK" PORPHYRY, SOUTHEASTERN ARIZONA Ariz. geol. soc. dig., v.7 pp. 87-96, incl. graphs, table, 6 ref., Nov. 1964
DLC unbound

"Turkey Track" porphyry, occurs in several localities over a widespread area in southeastern Arizona and is characterized petrographically by large weakly zoned plagioclase laths commonly over an inch in diameter and two pyroxenes or alteration after olivine in a gray to reddish-brown fine-grained glassy groundmass. The "Turkey Track" has been proposed as a correlation guide if it could be established that all Turkey Track localities represent on rock unit formed during a short interval of time. An attempt has been made to demonstrate by uniformity of trace-element content coupled with similarities in chemical and mineralogical composition the the Turkey Track localities probably do have a common parent. Concurrent K-Ar dating indicates that the Turkey Track localities were erupted or intruded penecontemporaneously. Andesite porphyries that are, or are similar to, the Turkey Track are found in several localities within roughly a 75-mile radius of Tucson.

476. Mayo, Evans B. STRUCTURE OF THE LARGE PHENOCRYST PORPHYRY NEAR ARIZONA-SONORA DESERT MUSEUM Ariz. geol. soc. dig., v.4 pp. 1-14, incl. illus., maps, 13 ref., Nov. 1961
DLC unbound

A number of small intrusions into Cretaceous (?) sediments occur near the Arizona-Sonora Desert Museum. Of these, two small masses with aphanitic matrix and large plagioclase phenocrysts form the subject of this paper. Their structure, origin and surroundings are described in some detail.

477. Ackerman, Bernice OROGRAPHIC-CONVECTIVE PRECIPITATION AS REVEALED BY RADAR Amer. Geophys. Union, Geophys. monograph, no.5 pp. 79-85, 1960 DLC

Summer cloud systems in the arid and mountainous region around Tucson, Arizona, are predominately convective in nature. Extensive radar observations of these systems have been made by the Institute of Atmospheric Physics, University of Arizona, using height-finding radar. A study of the level of formation of radar echoes, based on data collected during the summer of 1956, indicates that an all-water process, as well as one involving the ice phase, was effective in initiating precipitation. Moreover there appeared important day-to-day differences in the efficiency of the water mechanism.

478. Adolph, Edward F., R.E. Gosselin, and A.H. Brown PHYSIOLOGY OF MAN IN THE DESERT N.Y. Interscience, 1947 357 pp. Facsimile ed., 1969, Hafner Pub. Co. DLC QP82.A155 1969

A group of important papers by E.F. Adolph and an number of associates working under contract with the Committee on Medical Research of the US Office of Scientific Research and Development. Many physiological processes such as sweating, heat exchange of the body, blood circulation, dehydration, urination, exhaustion, thirst, etc. were tested under desert or simulated desert conditions, and the quantitative results presented and analyzed. The problem of water losses of man on life rafts (Brown, Gosselin and Adolph) was considered and the solution involving maps of ocean temperatures, rainfall and winds discussed. The difference between wet bulb temperatures (with respect to comfort) in the desert and the tropics (humid) is illustrated graphically.

479. Aizenshtat, B.A. THE HEAT BALANCE AND MICROCLIMATE OF CERTAIN LANDSCAPES IN A SANDY DESERT Transl. from: Sovremennye problemy meteorologii prizemnogo sloya vozdukha: sbornik statei, Leningrad, 1958, pp. 67-130. US Weather Bur., TT-61-23404, Oct. 1960, 92 pp. AD 660 986

The study is on the radiation and heat balance, and of the microclimate of landscapes typical for sandy deserts of Soviet Central Asia. The purpose of the expeditions was to investigate in greater detail insofar as possible, the radiation and heat balances of the more common landscapes of sandy deserts and thereby to obtain a concept of conditions under which the microclimate of these landscapes is formed and to determine the order of the value of their microclimatic differences.

480. Al Naqib, K.M. GEOLOGY OF THE ARABIAN PENINSULA, SOUTHWEST IRAQ US Geol. Survey, Prof. paper 560-G, pp. G1-G54, 42 ref., 1967 DLC QE79.P9

The topography of southwestern Iraq includes mudflats and sebkhas of the Mesopotamian alluvial plain, a mobile sand-dune belt in the east, the gravel and the sand plains of the Ad Dibdibba zone, the Al Hajara limestone country which is composed mainly of enclosed depressions, scarps and mesas, and the deeply dissected limestone topography of the Al Widyan area. The only important Quaternary sediments comprise the marine Hammar Formation.

481. Alekseev-Shemyakin, V.P. and O.S. Fedorova PECULIARITIES OF IDENTIFYING FIELD PREPARATION POINTS UNDER CONDITIONS OF SHIFTING SANDS Transl. of Fotogrammetricheskaya obrabotka i deshifirovaine aerosnimkov, Leningrad, 1967 pp. 149-55. Aeronautical Cahrt and Infromation Center, St. Louis, Mo., Linguistics Section, ACIC-TC-1293, Oct. 1967, 16 pp. AD 660 906 HC \$3.00 MF \$0.65

In a stereographic survey of shifting sands, the greatest difficulty is met in the local identification of field inspection points for horizontal and vertical control. On all air photos, the vegetation in sandy deserts is distinguished by the difficulty of recognizing individual plants. In the formation of the point image it becomes almost impossible to distinguish the shrub, the mound around it and the shadow of the shrub and mound. A study of photos from repeated flights over a single tract of desert was made (4 times in 8 years). Conclusions drawn were that identification of feature points in standard picture portions was possible in only about 40% of all photos. After 8 years, only 3-5% of all feature points were identifiable. Methods and suggestions are given for taking flight photos in which field feature points will be identifiable more readily.

482. Allen, C.R. and others THE BORREGO MOUNTAIN, CALIFORNIA, EARTH-QUAKE OF 9 APRIL 1968: A PRELIMINARY REPORT Seismol. soc. Amer., bull., v.58, no.3 pp. 1183-86, June 1968 Also: Calif. Div. Mines and Geology, Mineral inform. serv., v.21, no.7 pp. 103-06, 1968 DLC QE531.S3: HD9506.U63C35

Caused by right-lateral displacement along the Coyote Creek fault -- a major branch of the San Jacinto fault zone -- the break has two NW-trending, en echelon segments, with a maximum noted displacement of 38 cm northwest of Ocotillo Wells. The trace was within Quaternary alluvium and lake beds, except at the northernmost extremity, where branches cut steeply dipping beds of the Palm Springs Formation, and in Ocotillo Badlands where the Borrego Formation and Ocotillo Quartzite were displaced. In every area of pre-existing faults, the rupture followed earlier breaks. Minor breaks and creep, noted up to April 28 on other faults in the system, must have been triggered by this earthquake.

483. Allen, Clarence R. SAN ANDREAS FAULT ZONE IN SAN GORGONIO PASS, SOUTHERN CALIFORNIA Geol. Soc. Amer., bull., v.68 pp. 315-50, incl. illus., maps, ref., March 1957
DLC QEl.G2

Unusual features of the San Andreas fault in the San Gorgonio Pass area of Southern California are the absence of rift topography, absence of lateral stream offsets, and abrupt change in trend of the fault trace, seismic evidence for the predominance of thrusting over strike-slip faulting, and a lack of great earthquakes in historic time. Within San Gorgonio Pass, the San Andreas fault curves abruptly southward from its normal southeast trend and butts into the eastward-trending Banning fault of 45° . The Banning fault is a major tectonic feature that delineates the north side of the pass and forms the southern limit of the Transverse Ranges in this region. Thrust and reverse movements of at least 5000 feet have taken place on this fault in Quaternary time, and, although there is little evidence of Recent lateral displacements, late Pliocene and Pleistocene right-hand strike-slip movements totaling at least 5 miles are suggested. The Mill Creek and Mission Creek faults are major branches of the San Andreas fault that diverge northward; both evince considerable late Cenozoic vertical displacement, but possible lateral movements are unknown. This study neither proves nor disproves the existence of lateral displacements amounting to perhaps hundreds of miles along the San Andreas fault zone as a whole. But if large lateral displacements have taken place, they must have been followed by deformation and disruption of the fault traces then existent, because lateral movements of even 1 mile are difficult to reconcile with the complex surface geometry of faults within the pass area. Faults previously considered branches of the San Andreas, particularly the Mission Creek and San Jacinto faults, may have absorbed much of the lateral strain, and the Banning fault may represent a pattern that is typical of the entire eastern half of the Transverse Ranges, where elements of San Andreas and Transverse Range structure have been vying for control; evidently one set has alternated with the other in attaining temporary dominance. Southeast of San Gorgonio Pass it is not clear which, if any, fault trace deserves the name of San Andreas, and it is suggested that the entire area between the Elsinore fault on the west and the east side of the Salton depression on the east be termed the San Andreas fault zone.

484. American Association for the Advancement of Science
CLIMATE AND MAN IN THE SOUTHWEST: A SYMPOSIUM HELD BEFORE
THE 33RD ANNUAL MEETING OF THE SOUTHWESTERN AND ROCKY
MOUNTAIN DIVISION OF THE AAAS, APRIL 30, 1957, TUCSON, ARIZONA
Ariz. Univ., bull., v.28, no.4 Nov. 1957; Program
in Geochronol., Contribution no.6, 1958 84 pp. DWB
M83.7S641C. DLC GB124.S6A6 1957

The problems discussed include: (1) C^{14} dating and the possible influences of glaciation, ocean levels, soil air and organic use of CO_2 on the ratios which are used to determine chronology, polynology or pollen analysis, paleontology, geochemistry, and geomorphology; (2) extent of continental glaciation in the US and in the Cordillera, and their correlation, changes in lake levels, streams, etc. not associated with glaciation, and absolute chronology of late Pleistocene events. It is concluded that there have been a number of continental and mountain glaciations in the US and corresponding climatic changes, but just how many or how intense is still a matter of conjecture or at least of controversy. A good bibliography of pleistocene glaciation in the US is appended. (3) recharge, discharge, storage and use of ground water and surface water by man, and the current status of the water table, and data on its levels in Arizona. (4) earliest valid date for human occupancy of Southwestern US as 12,000 B.P., or just prior to the Man-kato stage -- possibly, 15-25 thousand B.P. but hardly less than 37,000, as some claim. Climatic changes are discussed in connection with man's adjustment to his habitat after glaciation when rainfall and vegetation were much greater, and during the climatic optimum when a serious shortage of moisture resulted from the higher temperatures about 5000 B.C.

485. Amer. Association for the Advancement of Science. . . Committee
on Arid Lands GUIDEBOOK OF NORTHERN MEXICO SONORAN DES-
ERT REGION Tucson, Univ. of Ariz., 1969 53 pp. + map

This guidebook was used for a ten day excursion into the Chihuahuan and Sonoran desert regions and the mining districts of northern Mexico as part of the International Conference on Arid Lands, Tucson, Arizona, 1969, sponsored by the AAAS and the University of Arizona. The trip traces the route: Ciudad Juarez -- Chihuahua City -- Jiminez -- Durango -- Mazatlan -- Los Mochis -- Guaymas -- Cananea -- Tucson. Brief articles are included that describe the vegetation of the Sonoran and Chihuahuan deserts, the geology and the climatology of the regions covered. The guidebook is available from the Office of Arid-Lands Studies, University of Arizona, Tucson, Arizona.

486. Amiran, David H.K. SYMPOSIUM ON COASTAL DESERTS (AND CHANGES IN OCCUPANCE OF ARID AREAS, PERU, APRIL 3-21, 1967.) Nature and resources (Paris); v.3, no.4 pp. 11-13, Dec. 1967

Reviews the 36 papers presented at the symposium, lists the areas studied in the field during the northern and southern excursions, and presents the general resolutions proposed by the Arid Zone Commission of the International Geographical Union which organized the symposium with assistance from UNESCO.

487. Anda, L.F. de and E. Oaredes THE SAN JACINTO FAULT AND ITS INFLUENCE ON GEOTHERMIC ACTIVITY IN THE MEXICALI VALLEY, BAJA CALIFORNIA, MEXICO (La falla de San Jacinto y su influencia sobre la actividad geotermica en el Valle de Mexicali, Baja California, Mexico) Asoc. Mexicana geologos petroleros Bol., v.16, no.7-8 pp. 179-81, incl. illus., 1964 DLC QE1.A73

Areal geology of the Valle de Mexicali, Baja California, is outlined; geomorphologically the valley forms a part of the Colorado River delta; structurally its main faults -- the Cucapas, San Jacinto, and Imperial -- belong to the San Andreas system. Development of geothermal energy as a source of electricity in the Valle de Mexicali is discussed; at Cerro Prieto, one well (M-3), is in production, another (M-4), is being developed. These and several non-productive wells are shown in relation to the San Jacinto and other faults, and to isotherms of the area.

488. Anderson, Charles A. AREAL GEOLOGY OF THE SOUTHWEST In Geology of the porphyry copper deposits, southwestern North America Tucson, Univ. of Ariz. Press, pp. 3-16, incl. illus., tables, 1966 DLC QE79.5.T55

The paper is focused on the features that may be germane to the location and distribution of porphyry copper deposits, which limits it largely to Arizona and southwestern New Mexico. The physiography of the Colorado Plateau-Basin and Range area is reviewed, and the Precambrian geology discussed in detail. Paleozoic and Mesozoic sedimentation was followed by Cretaceous and early Tertiary deformation. Mesozoic and younger plutonic rocks are described. The Plateau and Basin and Range province both came into existence during the Cenozoic, and their history is reviewed. The possibility of a relationship between regional potassium-sodium ratios and the distribution of copper is discussed briefly.

489. Arizona, University INTERDISCIPLINARY STUDY OF THE UTILIZATION OF ARID LANDS: FIRST ANNUAL REPORT Issued June 1, 1959, by the Arid Lands Project of the University of Arizona 26 pp., incl. map, diagr. DWB 85.53 A719ut

A report on the disciplinary study of the fundamental biological and physical mechanisms at work in arid regions. This report on the utilization of arid lands is part of the "Arid Land Project." It summarizes the work done (in Arizona), in progress, and plans for further research. Progress reports on archaeology, biology, climate, geochronology and geohydrology are included. Basic climatic data on Arizona have been collected and will be published shortly.

490. Arizona University Library CHECKLIST OF THESES AND DISSERTATIONS ACCEPTED FOR HIGHER DEGREES AT THE UNIVERSITY OF ARIZONA THROUGH 1946 Compiled by Clinton E. Colby Tucson, Univ. of Arizona Library, 1965 52 + 12 p. DLC Z5055.U5A793

All theses submitted to the University through 1946 are listed within broad subject classes. An author index is also provided.

491. Arnal, Robert E. LIMNOLOGY, SEDIMENTATION, AND MICROORGANISMS OF THE SALTON SEA, CALIFORNIA Geol. soc. Amer. bull., v.72, no.3 pp. 427-78, incl. illus., tables, 40 ref., March 1961 DLC QE1.62

The Salton Sea was originally a fresh-water lake formed by the flood of the Colorado River in 1905. By 1929, the water of the lake had become almost as saline as ocean water because of intense evaporation and solution of salts present on the floor of the basin before the flood. In recent years in spite of the high rate of evaporation, excess runoff from irrigation water has maintained and even raised the level of the lake. Evaluation of the water budget has made it possible to anticipate future change in the chemical composition of the water -- i.e. an increase in the amount of sulfates is predicted for the future. Measurements with a current cross and studies of salinity distribution indicate a counter-clockwise current pattern in the Salton Sea. Sands, silts, and clays are deposited in that order from shoreline to the center of the lake. The water content, amount of calcium carbonate, and textural characteristics indicate that most of the sediments of the Salton Sea were derived from the suspended load of the Colorado River, whereas the mineralogical study suggests that some of the sediments have a local origin.

492. Aronovici, V.S. LABORATORY EVALUATION OF DESERT SOILS FOR IRRIGATION Amer. geophys. union, trans., v.33, no.1 pp. 49-52
January 1952 DLC QC811.J6

A simple laboratory technic of evaluating desert soils for suitability to irrigation is outlined. Such laboratory observations are for the purpose of augmenting a field examination of physiographic and pedological limitations of the land. The method is based upon the premise that soil moisture retained against a tension of 100-cm water tension, less the moisture retained against 15,000-cm tension, gives an index of total available water in the soil. The importance of the relative distribution of available moisture within the tension range of 100 and 15,000 com is indicated.

493. Ashburn, Edward V. and Rodney G. Weldon SPECTRAL DIFFUSE REFLECTANCE OF DESERT SURFACES Optical soc. Amer., jour., v.46, no.8 pp. 583-86, incl. illus., table, graphs, ref.
August 1956 DLC QC350.06

The spectral diffuse reflectance of various types of desert terrain was measured at 500 A intervals in the spectral range 4000A to 6500A. For all types investigated, except basaltic lava, the diffuse reflectance increased with increasing wavelength of the incident radiation. In general, the diffuse reflectance at 6500A was approximately twice that at 4000A. The various types of surfaces showed large differences in diffuse reflectance; the values ranging from 0.03 to 0.74. Measurements made of radiance from a surface of brush and wind-blown sand showed that reflection does not follow Lambert's law. Data presented in this paper was derived from studies in the Mojave Desert.

494. Benson, Lyman David THE CACTI OF ARIZONA 2nd ed. Tucson, University of Arizona Press, 1950, 134 pp., incl. illus., 15 maps DLC QK495.C11B35 1950

The cacti native to Arizona are described in semi-technical language. Seventy-two species and four varieties in Opuntia, Cereus, Echinocereus, Echinocactus and Mammillaria are enumerated; twenty-one other species and varieties of more or less dubious status are referred to without number. Data supplementing descriptions include habitat, altitudinal and geographic distribution within Arizona, general range, and for 60 species, maps indicating the Arizona distribution. Synopses and keys to the genera, and keys to the species are included.

495. Jaeger, Edmund Carroll DESERT WILDLIFE Stanford University Press, 1961 308 pp. DLC QL6116.J25 1961

Provides a series of sketches depicting the lives of native animals in our southwestern deserts. Mammals and birds are given specially full treatment.

496. Shreve, Forrest and Ira L. Wiggins VEGETATION AND FLORA OF THE SONORAN DESERT Vol. 1, 840 pp., vol. 2, 900 pp., incl. illus., maps, ref. Stanford, Stanford University Press, 1964 DLC QK938.D4S49 1964

Part I, which comprises pp. 1-186, has long been considered the best as well as the standard publication on the subject. In this edition, the original plates have been supplemented by many new photographs. The region comprises the arid parts of SE California, Arizona, Baja California and Sonora below 1000 m elevation. Climatic and physiographic conditions of the region are outlined and "Sheetflood erosion" and its relations to soil problems are discussed. A short description of the 4 main deserts of North America and their contrasting features is followed by the detailed account of the perennial vegetation and the life forms of the Sonoran Desert. Seven vegetational subdivisions are recognized and 3 sets of equivalent names assigned to them which refer to their ecological features, to the most distinctive genera and to their geogr. location, respectively. Their distribution is shown on a colored folding map. The ephemeral herbaceous vegetation is described.

497. Robison, William C. and Arthur V. Dodd ANALOGS OF YUMA CLIMATE IN CHINESE INNER ASIA US Quartermaster Res. & Develop. Cent., Environmental Protection Div., Yuma Analogs No. 6, Dec. 1955, 16 pp., 16 ref. DWB M82.1 U586an; AD 200 770

In summer one small area -- the Turfan Depression in Sinkiang -- is much like Yuma in respect to temperature and precipitation. Considering only mean temperature for the warmest month, for which the Yuma value is 91°F the area of comparability (with 5°F) also includes the valley of the Wei Ho in Shensi province. A large portion of the study area has mean annual precipitation between 2 and 6 in., and is therefore considered analogous to the Yuma mean of 3.4 in. Much of the Tarim Basin has a mean of less than 2 in., and is thus semi-analogous to Yuma. The entire area has mean cloudiness greater than 3.0 in July, too high to analogous to the Yuma average of 1.6 tenths. Mean July wind speeds are analogous or semi-analogous (less than 12 mph) at stations for which data are available. Most of Chinese Inner Asia has

lower dew points than Yuma; only in the more humid southeast are dew points of the same order as or higher than the August value of 64°F at Yuma. Areas of analogy of pertinent climatic elements are presented in a series of maps at the end of the report.

498. Reitan, Calyton H. and Christine R. Green INVENTORY OF RESEARCH ON WEATHER AND CLIMATE OF DESERT ENVIRONMENTS Chapter II of an inventory of geographical research on desert environments Arizona University Office of Arid Lands Studies, 1967 72 pp., 100+ ref. (US Army Natick Labs., TP 248) AD 664 641

A thorough discussion of the current state of knowledge concerning: climatic data in general, climatic data for each desert, synoptic climatology, weather systems, desert storms, upper-air circulations, aridity, climatic typing and indexes of aridity, weather modification, microclimate and radiation. In addition, the level of current research for each of the major deserts of the world is discussed, and an annotated bibliography included.

499. Jaeger, Edmund C. NORTH AMERICAN DESERTS Stanford Univ. Press, Stanford, California, 1957 (reprinted 1967)

A popular treatment of the North American deserts with a overview on weather and climate, the Sonoran Desert and its subdivisions, including a chapter on the flora and fauna of the Yuman Desert. Sections are included on insects, reptiles, birds, mammals and plants, as well as a bibliography.

500. Kolb, C.R., and J.R. Van Lopik ANALOGS OF YUMA TERRAIN IN THE SOUTHWEST UNITED STATES DESERT, Vol. 1 US Army Engineer Waterways Experiment Sta., Vicksburg, Miss., Tech. rept. 3-630, Rept. no. 5, 50 pp., June 1963 AD 466 089, CFSTI HC \$2.00; MF \$0.50

To evaluate the adequacy and suitability of the Yuma Test Station as a test site representative of world desert conditions, it was necessary to determine to what extent Yuma terrain types occur in the Southwest United States (SWUS) desert and other world deserts. For valid comparisons, a uniform system of describing, mapping, and comparing desert terrain is necessary. In Vol. II of this report, both the Yuma Test Station and the SWUS desert are mapped in terms

of general geometry, ground, and vegetation factors. The data mapped for each terrain factor in each desert area were then synthesized to establish the degree of analogy of a particular SWUS area with selected portions of the Yuma area. Final terraintype analog maps were prepared by superimposing the geometry, ground, and vegetation analog maps and stratifying the resulting combinations. Highly analogous SWUS desert tracts exhibit combinations of terrain-factory mapping units found at Yuma, and the degree of analogy decreasing as the similarity to such combinations decreases. Vol I of the report summarizes the analogy, and describes and discusses the factors used and the mapping technique. Appendix A in a general discussion of the philosophy and problems associated with terrain analysis and comparison.

501. Nelson, Ronald A. ANALOGS OF YUMA CLIMATE IN EAST CENTRAL AFRICA (YUMA ANALOGS, NO. 7) US Quartermaster Res. & Eng. Command, April 1956 28 pp. AD 200 171

Climatic analogies with Yuma for most elements are restricted to relatively small areas. Temperatures during the warmest month are analogous along the narrow coastal strip that borders the Red Sea and Gulf of Aden, and in sections of interior Somalia and Kenya. The coldest months have analogous temperatures at elevations above approximately 6000 feet. Owing to the greater annual range at Yuma, there is an overlap in East Central Africa between areas of temperature analogy for the warmest and coldest months. Areas of analogous mean annual precipitation (2-6 inches) coincide largely with the coastal area of warmest month analogy, and occur in the interior only in an isolated pocket adjacent to Lake Rudolf. Mean annual rainfall is less than 2 inches (semianalogous, drier) in two narrow coastal areas of Eritrea and British Somaliland. Mean dew points are considerably higher in the coastal areas than at Yuma, and are analogous only at the intermediate elevations in the interior. Mean cloudiness in July is analogous or semianalogous in the lowland regions adjacent to the Red Sea and Gulf of Aden, and on the northern coast of Somalia. In July, wind speeds are analogous at both coastal and inland stations within Eritrea, and at several stations along the Ethiopian-Sudanese border; elsewhere, wind data are largely lacking. There is no complete all-year analogy to Yuma climate. However, the coastal plain bordering the Red Sea and the Gulf of Aden resembles Yuma in many respects and is the closest counterpart to be found within the study area.

502. McGinnies, William G. INVENTORY OF RESEARCH ON VEGETATION OF DESERT ENVIRONMENTS Chapter VI of, An inventory of geographical research on desert environments. Arizona University. Office of Arid Land Studies, 1967, 184 pp., 100+ ref. (US Army Natick Labs., TP 367) AD 668 852

Reviews and evaluates existing information and research on the vegetation of the deserts of the world, to ascertain the notable deficiencies, and to propose possible future research and improvements to the knowledge of desert vegetation. Items considered to be of major importance for the purpose of this inventory are: (1) physiognomy of major species; (2) relative abundance of trees, shrubs, succulents, herbs, grasses; (3) seasonal variation in composition, including year-long or seasonal duration of all elements of the vegetation; (4) seasonal aspects, including changes in structure or color; (5) effects of plants on the habitat; (6) resistance to unfavorable conditions; and (7) economic uses.

503. Lowe, Charles H. INVENTORY OF RESEARCH ON FAUNA OF DESERT ENVIRONMENTS Chapter VII of An inventory of geographical research on desert environments. Arizona University. Office of Arid Lands Studies, 1968, 77 pp., 100+ ref. (US Army Natick Labs., TP 373) AD

The present state of knowledge regarding taxonomy, distribution and general ecology of native animals (fauna) in the 13 major deserts of the world is estimated and discussed. Topical discussions center on poisonous animals, food, pests, and disease in the desert. Physiological ecology of native and introduced species in the deserts is an important subject that is not given topical discussion, although appropriate remarks and conclusions are given. The bibliography provides annotations for the more important works.

504. NORTH AMERICA ANALOGS Res Study Rep RER-12, "Analog of Yuma Climate in North America," QMR&D Center, Natick, Mass., January 1957

Contains comparison of climate elements including temperature, precipitation, dew point, cloudiness and wind speed and direction.

505. US Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss. PROJECT OTTER (OVERLAND TRAIN TERRAIN EVALUATION RESEARCH); PRETEST REPORT, by C.R. Kolb and J.H. Shamburger December 1961, vii, 29 pp., incl. illus. (Technical Report No. 3-588, Report 1) Unclassified

Performance in desert areas of the Overland Train, a logistical cargo carrier, is to be tested in 1962 at the Yuma Test Station by the US Army Transportation Research Command (TRECOM). To realistically evaluate test results, TRECOM needs to know the representativeness of the terrain over which the Overland Train is tested compared with world desert terrain conditions. Projects concerned with terrain analysis and evaluation have been conducted at the Waterways Experiment Station (WES) for several years, and a classification system and technique for mapping terrain factors have been developed. Many deserts, including that at Yuma, have been mapped. From the Yuma terrain factor maps, test courses for the Overland Train were tentatively selected. A major field investigation was then conducted of these courses. Terrain types classified according to the WES system along nine of the courses are tentatively compared to the terrain of world deserts. Additional reports are planned after actual testing is completed.

506. Middle East Analogs Res Study Rep RER-1 ANALOGS OF YUMA CLIMATE IN THE MIDDLE EAST QMR&D Center, Natick, Mass., March 1954 (rep 57)

Contains comparison of following elements of climate: temperature, precipitation, prevailing wind speed and direction, cloud cover, and visibility.

507. Bagnold, R.A. THE PHYSICAL ASPECTS OF DRY DESERTS In Institute of Biology, Biology of deserts N.Y., Stechart-Hafner, 1954, pp. 7-12 DLC GB611.15 1954

The author describes the general characteristics and meteorological causes of dry deserts, the effect of surface relief, soil and geology on the absorption and storage of desert rainfall, moisture variation in wind erosion deserts, the interannual variability of rainfall in deserts, the mean effective rainfall (Libyan Desert), the mean rainless period, influence of rain on nomadic life, the effect of small long-period rainfall, changes of cloud and rain season and changes of wind direction on plant cover and the biological limit of deserts.

508. Bagnold, Ralph A. THE PHYSICS OF BLOWN SAND AND DESERT DUNES
London, Methuen & Co., 1954, 265 pp. DLC QE579.B3 1954

The book is concerned with the phenomena produced by the action of wind on sand; wind-tunnel experiments on the mechanism of sand transport; small-scale surface phenomena such as ripples and problems of size-grading of grains; the growth and movement of dunes in general; and the peculiar characteristics of two main types of dunes.

509. Baker, Paul T. THEORETICAL MODEL FOR DESERT HEAT TOLERANCE
US Army Quartermaster Research and Engineering Center, Natick
Mass., Tech. rept. EP-96, July 1958, 33 pp., 37 ref.
PB 135 853: Order from LC, mi \$3.00, ph \$6.30

Experimental and acturial data indicate that there is a high degree of individual variance in ability to tolerate hot desert conditions. The same data also show that a significant percentage of this variance is correlated to morphological characteristics. From these relationships a "model" was constructed. The model or "idea" man for tolerance of desert heat was found to be linear, low in subcutaneous body fat, acclimatized, and of brunette skin color.

510. Barrows, David P. THE COLORADO DESERT Natl. geogr. mag.,
v.11, pp. 337-51, incl. illus., 1900 DLC G1.N27

This early article describes the general physiographic features of the Colorado Desert.

511. Belly, Pierre-Yves SAND MOVEMENT BY WIND US Army Corps
engineers, Coastal Eng. Res. Cent., Tech. memo No. 1,
1964, 38 pp., 8 ref.

Although the grain size of the sand used was very different from that used by Bagnold and Kawamura, these experiments reaffirmed their findings with respect to rate of sand transport. The average flying distance of the sand particles was found to be much greater than that found by previous investigators, but the difference could possibly be due to the method of calculation. The experiments seem to prove that sand movement has a negligible response time to a change in wind velocity.

512. Blasquez L., Luis HYDROGEOLOGY OF THE DESERT REGIONS OF MEXICO (Hidrogeologia de las regiones deserticas de Mexico) Text in Spanish. Mexico (City) Universidad Instituto de geofisica, anales, v.15 172 pp., incl. tables, 47 ref. DWB DLC QE201.M4

The deserts and the arid, semi-arid and sub-humid zones of northern Mexico comprising Baja California, Sonora, Casas Grandes, Conchos, Bolson de Mapimi, Cuenca de Mayran and Valle Salado are shown on a map. The physiography, hydrography and the geology of these areas are described. Profiles and maps showing watershed boundaries and other physiographic, topographic, and hydrographic indices are tabulated for each area. Geologic maps are presented and discussed. Meteorological and climatological, (including KOPPEN'S LANU'S and THORNTHWAITE'S) classifications are tabulated and discussed. Ground water, spring flow, precipitation, stream flow, infiltration and evaporation data are included.

513. Bollen, W.B. and S. Nishikawa SYSTEMATIC DESCRIPTION AND KEY TO STREPTOMYCES ISOLANTS FROM CHILE, ARIZONA, AND ANTARCTIC DESERT SOILS Jet Propulsion Lab, Calif. Inst. Tech., Pasadena, Calif., and Oregon State Univ., Corvallis, Oregon Feb. 18, 1969 215 pp. NASA-CR-100445 N69 21223

Sixty-seven isolants have been examined. Thirty-seven have been identified; nine were cultered on the various media but could not be classified and were designated "indeterminate"; twenty could not be subcultured from the original slants. With the exception of two, non-sporulating cultures, all streptomycete cultures isolated from Antarctica desert soil were identified as Streptomyces longisporoflavus. The non-sporulating cultures may be variants of S. longisporoflavus as their colony characteristics are similar to other cultures which have been identified as S. longisporoflavus. The materials and methods used to characterize the isolants listed in this report are identical to those described in the first of the reports on the streptomycetes.

514. Brant, Arthur A. GEOPHYSICS IN THE EXPLORATION FOR ARIZONA PORPHYRY COPPERS In Geology of the porphyry copper deposits, Southwestern North America, ed. by S.R. Titley and C.L. Hicks Tucson, University of Arizona Press, 1966 pp. 87-110, incl. illus., tables, ref. DLC QE79.5.T55

Magnetic surveys and induced polarization are used most widely in exploration for porphyry coppers of Arizona. Under the first, a summary of survey results, some simple interpretive guides, and field examples are given. For induced polarization, the basis of the method, responsive minerals, systems of measurement, field procedures, and examples of field data are discussed. Accessory use has been made of electromagnetic, gravity, and AFMAG surveys, and these are described briefly.

515. Brown, John S. THE SALTON SEA REGION, CALIFORNIA. A GEOGRAPHIC, GEOLOGIC, AND HYDROLOGIC RECONNAISSANCE WITH A GUIDE TO DESERT WATERING PLACES US Geol. Survey, Water supply paper 497, 1923 292 pp., incl. illus., maps (in pocket) DLC TC801.U2

This early monographic on the Salton Sea region includes a detailed study of the history, climate, flora, fauna, physiography, drainage, geology, mineral resources, hydrology, along with road logs accompanied by extensive descriptions of the entire area. An interesting and useful bibliography of southeastern California includes many early works on the history, engineering, geology, geography, natural history, engineering, geology, geography, natural history and water supply of the region. Detailed maps are included (in pocket).

516. Brown, John S. FAULT FEATURES OF THE SALTON BASIN, CALIFORNIA Jour. geol., v.30, no.3 pp. 217-26, incl. map, 6 ref. April-May 1922 DLC QE1.J8

The general features, surrounding mountains, basin floor, stratigraphy, and the formation of the basin are described briefly, followed by a discussion of the Indio fault, the faults running southwest of the Salton basin, the valleys formed by faulting, and the type and age of the faulting. A reconnaissance map of the geology and topography of the Salton basin and vicinity is included.

517. Brown, W.H. TUCSON MOUNTAINS, AN AIRZONA BASIN RANGE TYPE
Geol. soc. Amer. bull., v.50, no.5 pp. 697-760, 1939
DLC QE1.G2

The study of the mountains has shown the presence of sediments ranging in age from Cambrian to Cretaceous, and Cretaceous, Tertiary, and Pliocene or Pleistocene effusives. Laramide intrusives cut Laramide folds and a Laramide thrust fault, which is remarkable in its preservation. The fault was practically parallel with the early Tertiary erosion surface, and only a thin veneer of the overthrust block is preserved below the Tertiary lavas. The events in the historical sequence have been dated by the discovery of invertebrate remains in the cretaceous sediments and plant remains in a Tertiary tuff. The great reduction of the range by erosion and the burial of its outer edges have concealed the hypothetical Basin and Range border faults, but the predominance of steep-angle normal faulting in the Tertiary rocks of the range indicates a similar structure of the buried borders. A complicated erosional history is indicated by the presence of pediments, probably of three different ages, and evidence of a former greater burial of the range in its own debris.

518. Buol, S.W. and M.S. Yesilsoy A GENESIS STUDY OF A MOHAVE SANDY LOAM PROFILE Soil Sci. Cos. Amer., Proc., v.28, no.2 pp. 254-56, incl. tables, 21 ref. March/April 1964
DLC S590.S64A13

A Mohave sandy loam profile, representative of red desert soils, which developed in the Avra Valley in southern Arizona, was studied to determine its pedogenesis. A lithologic discontinuity at a depth of 60 inches separates the soil profile from an underlying caliche layer. Only a weak and relatively recent carbonate accumulation is pedogenically associated with the present soil surface. Kaolinite and illite are the predominant clay minerals in the upper layer. Thin sections reveal few clay skins developed in the profile.

519. Butzer, Karl W. DESERT LANDFORMS AT THE KURKUR OASIS, EGYPT
Assoc. Amer. geographers, ann., v.55, no.4 pp. 578-91, incl. illus., 1965 DLC G3.A7

The land surface of the Libyan Desert of the Kurkur area, west of Aswan, was originally modelled by running water in late Tertiary and early Pleistocene times but it has subsequently been remodelled by wind. The following characteristics are considered significant: (1) areas of smooth slopes and limited relief are dominant; (2) limited stream

dissection and, to some extent, disorganized drainage; (3) even where dissection is deep its texture is coarse; (4) areas of accentuated relief are characterized by steep rectilinear slopes, with angular breaks of slope above and below; (5) there are very few surfaces with slopes of between five and twenty-five percent; (6) differential weathering and erosion is conspicuous; (7) there is no soil mantle but extensive areas are covered by a lag veneer; (8) lag, talus and water transported scree are widespread but shallow; (9) thin alluvial and colluvial materials are also extensive, though usually thin are rarely reworked. A plea is made for more systematic studies of the differences in landform between arid and humid environments.

520. Butzer, Karl and C.R. Twidale DESERTS IN THE PAST In: E.S. Hills (ed.), Arid lands: a geographical appraisal. London Methuen, 1966, pp. 127-44, incl. illus., 34 ref.
DLC GB611.H5

Criteria of climatic change in the recent past include high abandoned lake shores, river terraces (difficult to interpret) evidence of palynology, lake deposits, fossil soils, dunes, dendrochronology and archaeology. The Sahara is used as an example to discuss the effect of minor climatic changes. The significance of changes in the wetter highland areas within large deserts is particularly stressed. Large lakes can be created by a relatively small increase in precipitation if it is coupled with a small fall in mean annual temperature. The pluvial periods of the Quaternary are divided into warm pluvials, characterized by red soils, and cool pluvials characterized by increased stream activity. The last 10,000 years shows a complex sequence and no universally applicable scheme is possible. The chapter concludes with a brief section describing evidence for past deserts in the geological record.

521. Buwalda, John P. and W. Layton Stanton GEOLOGICAL EVENTS IN THE HISTORY OF THE INDIO HILLS AND THE SALTON BASIN, SOUTHERN CALIFORNIA Science, v.71, no.1830 pp. 104-106, Jan. 24, 1930 DLC Q1.S35

In light of investigation and present knowledge, it is considered highly probable that, instead of being a cut-off and dessicated area of the Gulf of California, the present Salton Basin sank below sea level while the Colorado River excluded the Gulf by maintaining a dam in the form of a huge alluvial cone across the southern portion of the basin.

522. Butzer, Karl W. and Carl L. Hansen DESERT AND RIVER IN NUBIA: GEOMORPHOLOGY AND PREHISTORIC ENVIRONMENTS AT THE ASWAN RESEVOIR
Madison, University of Wisconsin Press, 1968, 562 pp., ref.
\$17.50 DLC QE328.B8

MAP SUPPLEMENT (Madison, 1968) 8 sheets of maps
64 X 97 cm and 43 X 48 cm. Scale of principal maps 1:42,000
DLC G8301.C5A8 1968.B8 \$10

A well-written account of the bedrock framework, the geomorphic and sedimentary history, the prehistoric populations, and the flora and fauna of the Nile Valley in Lower Nubia, of the Kurkur Oasis 55 km west of the Nile in the Libyan Desert, and of the Red Sea littoral near Mersa Alam. Several sections are devoted to present-day geomorphic processes (or lack thereof) that can be observed in the area, and there are good summaries of climatic and historic information.

523. Byers, Horace R. PHYSICS OF WINTER PRECIPITATION IN THE DESERT
In: Bert Bolin (ed), The atmosphere and the sea in motion.
New York, Rockefeller Inst. Press, 1959, pp. 400-12, incl.
illus., tables, 12 ref. DLC QC852.B65

Airplane and radar measurements in winter rain situations in the vicinity of Tucson, Arizona, are plotted and discussed. A combination of stratified cloud layers and convective cells predominates, the cellular types being more in evidence than in winter situations of the more humid regions of this and higher latitudes. The cloud droplet sizes and liquid water contents are similar to those measured elsewhere in the given ranges of temperature. A tabulation of the freezing level on rainy days shows that it varies widely but has a median around 8500 feet in January-March which is 2500 feet lower than the mean for all winter days. In some cases precipitation occurs by an all-water process. Counts of giant salt nuclei are high enough to play a role in such a process.

524. Byers, Horace R. SIGNIFICANCE OF DIFFERENT VERTICAL DISTRIBUTIONS OF WATER VAPOR IN ARID AND HUMID REGIONS Ariz. Univ. Inst. Atmos. Phys., Tech. repts. on meteorol. and climatol. of arid regions, No. 3, March 15, 1957, 13 pp., 10 ref. DWB

The vertical distribution of water vapor can be expressed by an index coefficient which provides information about eddy and advective transports in a region, or in an air mass. The relationship between evapotranspiration and eddy diffusivity of water vapor can be studied in this way. Striking differences in conditions between the arid Southwest and the remainder of the country are shown.

525. Brown, Slater WORLD OF THE DESERT Indianapolis, Bobbs-Merrill, 1963, 224 pp. DLC GB611.B7

A popular type of work, this book describes the great deserts of the world and the people who inhabit them. One chapter is devoted to the Great American Desert.

526. California. Dept. of Water Resources DESERT AREAS OF SOUTHEASTERN CALIFORNIA: LAND AND WATER USE SURVEY, 1958 Its Bull. no. 101, January 1963, 74 pp., incl. illus., maps, appends., 10 ref. DLC TD224.C3A53 1963b

This report contains the results of a comprehensive survey conducted by the Department to determine the nature and extent of land and water use within the southeastern desert area of California. Areas treated include Kern, Los Angeles, San Bernardino, Riverside, San Diego, and Imperial Counties that drain internally into lakes or dry lake beds, and the easterly portions of San Bernardino, Riverside, and Imperial Counties tributary to the Colorado River. Historical land use development and changes, and an estimate of the present levels of water use are discussed.

527. Cameron, R.E. PROPERTIES OF DESERT SOILS In Biology and the exploration of Mars. Washington, National Academy of Sciences National Research Council, Publ. 1296, pp. 164-86, incl. illus. tables, 1966

In desert areas there is a noticeable dearth of organisms; consequently they have little or no influence in the formation of true desert soils. Results from recent studies in the Great Basin, Mohave, and Colorado Deserts may illuminate the problems of sampling and detecting life; additional information comes from volcanic deserts of Hawaii, the Valley of 10,000 Smokes in Alaska, and high altitude areas in the White Mountains of California. Profile figures illustrate the various physical properties of the soils and related distribution of microorganisms; the latter is summarized in tables. Surface crusts are described which are very important microenvironments.

528. Cameron, Roy E., Gerald B. Blank and Doris R. Gensel
DESERT SOIL COLLECTION AT THE JPL SOIL SCIENCE LABORATORY
Jet Propulsion Lab., Calif. Inst. Tech., Pasadena, Calif.
NASA-CR-79873; JPL-TR-32-977, Oct. 15, 1966, 160 pp., incl.
ref. N67-11325; CFSTI, HC \$3.50; MF \$1.00

Desert soils and other geologic materials collected from 100 sites in desert regions comprise the Desert Soil Collection. Approximately 400 samples have been obtained from the surface to depths of 1 m since 1961, primarily from arid and semi-arid regions in the United States. Most of the samples are from California deserts. Additional samples have been obtained from arid states of Argentina and Chile, and Egypt, U.A.R. A list of samples in the Collection is provided in this report, along with descriptive information on the location and characteristics of the collection site, including photographs of the terrain and soil.

529. Cameron, R.E., F.A. Morelli, and H.P. Conrow
SURVIVAL OF MICROORGANISMS IN DESERT SOIL EXPOSED TO FIVE YEARS OF CONTINUOUS VERY HIGH VACUUM Calif. Inst. Tech., Jet Propulsion Lab, Tech. Rept. 32-1454, March 15, 1970, 11 pp., incl. illus., tables, 22 ref. AD

Survivability of indigenous aerobic, anaerobic, and micro-aerophilic bacteria, fungi, algae, and protozoa occurring as a microbial community in a Sonoran Desert algal soil crust was determined after 4 to 5 years of exposure to continuous very high vacuum of 10^6 to 10^8 torr. Aerobic and microaerophilic bacteria showed some decrease in survivability (approximately 1 log unit) after 4 and 5 years. In the sieved and powdered samples, there were no survivable thermophiles after 4 years and the numbers of algae were reduced from 10^6 to 10^2 per g of soil. No protozoa survived after 5 years in vacuum, but they did survive after 4 years.

530. Capot-Rey, R. COMMENTS ON SOME SAND SAMPLES FROM THE SAHARA
(Remarques sur quelques sables sahariens) Text in French
Institut de Recherche Sahariennes, Trav., v.23 pp. 155-63,
1964, 16 fig. DLC DT331.A4

Sands from the great ergs of the northern Sahara are compared with sand samples from the dunefields in the south. Only 24 samples are used and so the conclusions that can be reached are limited. It seems that the character of the sands depends more on the kind of dune and the position on the dune from which the sand is collected than on which erg it comes from.

531. Carnes, Patsy Sue TEMPERATURE VARIATIONS IN THE FIRST 200 FEET
OF THE ATMOSPHERE IN AN ARID REGION US Army. Signal Mis-
sile Support Agency, White Sands Missile Range, New Mexico
Data rept., July 1961, 138 pp. AD 266 802 CFSTI, \$11.00

532. Chebotarev, I.I. GEOCHEMICAL TYPES OF WATERS IN ARID REGIONS
Internatl. geol. cong., 20th, Mexico, 1956, Proc: Sect.
4, pp. 17-29, incl. tables, graphs, ref., 1957 DLC QE1.I6
The paper deals with the geochemistry of natural waters of the various occurrences (river waters, lake waters and subterranean waters) of the arid zone (North America, Europe, Australia, Middle East). The ionic composition and salinity concentration along with the genetic types and the qualitative classification of waters based on a mass of the assorted analytical data are represented in a number of summary tables and logarithmic diagrams.

533. Clayton, R.N., L.J.P. Muffler, and Donald E. White
OXYGEN ISOTOPE STUDY OF CALCITE AND SILICATES OF THE RIVER
RANCH NO. 1 WELL, SALTON SEA GEOTHERMAL FIELD, CALIFORNIA
Amer. jour. sci., v.266, no.10 pp. 968-79, 1968, ref.
DLC Q1.A5

The effect of temperature variation on isotope fractionation has been studied in rock samples from a well in the Salton Sea geothermal area. A vertical profile of oxygen isotopic composition of whole rock and separated minerals shows extensive exchange between hydrothermal solutions and the country rock. Carbonates and silicates have reached isotopic equilibrium at temperatures as low as 150° and possibly down to 100°C. In contrast to calcite, detrital quartz is remarkably resistant to isotopic exchange at temperatures as high as 340°C. For the main Salton Sea geothermal reservoir, at depths of about 3000 to 6000 feet, the volumes of water and rock that have undergone exchange are roughly equal.

534. Clements, R., R.H. Merrian, J.F. Mann, and R.O. Stone
AN EVALUATION OF TYPES AND SCALES OF AERIAL PHOTOGRAPHS FOR
USE IN ARID REGIONS Univ. of Southern California, Contract
AF33(616)-2175, 1955 AD 876 38

(not seen)

535. Clos-Arceuduc, A. DUNE ORIENTATION AND ITS RELATIONSHIP TO WIND
DIRECTION (La direction des dunes et les rapports avec
celle du vent) Acad. sci. Paris, comptes rend., ser. D
v.254, no.11 pp. 1393-96, 1967, 2 ref. DLC Q46.A14

Silk (plural slok) dunes are thin, linear dunes often found near, and probably derived from barchans. From air photos it is shown that such dunes are systematically arranged oblique to the wind. Elb (plural alab) dunes, another linear form, are shown to be similarly arranged at a defined angle to the dominant wind direction.

536. Cohen, Obadiah P. CLIMATE AND SOIL MOISTURE EXTRACTION Vol-
cani Inst. Agric. Res., Bet-Dagan, Israel, Final rept. on
contract Cwb-10836, 1968, 222 pp. PB 177 070: HC \$3.00;
MF \$0.65

This report deals primarily with evapotranspiration and the desert (the Negev). The object was to attempt to collect a long-term, comprehensive record of soil moisture and climatological data which would be made available to those who have need for such a record.

537. Colbert, Edwin H. RATES OF EROSION IN THE CHINLE FORMATION
-- TEN YEARS LATER Plateau, v.38, no.3 pp. 68-74, incl.
illus., table, 1966 DLC F806.P58

A series of marked stakes set in the Chinle Formation of Arizona has revealed erosion, even in this arid region, on a scale easily detected within a few years.

538. CONFERENCE ON GEOLOGIC PROBLEMS OF SAN ANDREAS FAULT SYSTEM, STANFORD UNIVERSITY, 1967, PROCEEDINGS. Sponsored by the School of Earth Sciences, Stanford University, and the National Center for Earthquake Research, US Geological Survey. Stanford, Stanford University Press, 1968, 374 pp., incl. illus., maps, ref. DLC QE606.C6 1967

Several short articles in this work relate to the Sonoran region. These include: R. Gordon Gastil, Fault Systems in Northern Baja California and Their Relation to the Gulf of California, pp. 283-286; Philip B. King, Regional Relationships of an Ancient Massif in Northwestern Sonora, pp. 288-289; and Richard H. Merriam, Geological Reconnaissance of North-Western Sonora, pp. 287; Robert V. Sharp, The San Andreas Fault System and Contrasting Pre-San Andreas Structures in the Peninsular Ranges of Southern California, pp. 292-293; Perry L. Ehlig, Causes of Distribution of Pelona, Rand, and Orocochia Shcists Along the San Andreas and Garlock Faults, pp. 294-306.

539. Cooke, Ronald U. MORPHOMETRIC ANALYSIS OF PEDIMENTS AND ASSOCIATED LANDFORMS IN THE WESTERN MOJAVE DESERT, CALIFORNIA Amer. jour. sci., v.269, no.6 pp. 26-38, incl. illus., graphs, ref., June 1970 DLC Q1.A5

Fifty-three pediments and their associated mountain areas and alluvial plains were studied in the western Mojave Desert. An attempt is made to describe and analyze some of the gross morphometric properties of these features. Statistical analysis of the data allows inter-regional and intra-regional comparisons, the relating of data to possible "explanatory" variables and to one another, and the testing of some "explanatory" hypotheses. Similarities and differences among some aspects of pediments and associated landforms in the western Mojave Desert and the Sonora Desert are identified. Pediment slope is shown not to be significantly related to pediment length, catchment basin area, or lithology, but it is significantly related to pediment association relief/length ratio. The exhumation hypothesis of pediment development is supported by some arguments based on the analysis of morphometric data.

540. Cooley, Maurice E. LATE PLEISTOCENE AND RECENT EROSION AND ALLUVIATION IN PARTS OF THE COLORADO RIVER SYSTEM, ARIZONA AND UTAH US Geol. Survey, Prof. paper 450-B, pp. 48-50, 8 ref., 1962 DLC QE75.P9

Multiple periods of alluviation, erosion, and terracing record the geologic events of late Pleistocene and Recent time in the Colorado River system. Although the amount and type of alluviation and erosion vary from one locality to another, the alluvial-erosional sequence is generally similar and is recognized in many drainages.

541. Cooke, R.U., and I.J. Smalley SALT WEATHERING IN DESERTS Nature, v.220, no.5173 pp. 1126-27, incl. ref., Dec. 21, 1968 DLC Q1.N2

Weathering of rocks as the result of pressures exerted by the crystallization of salts from solutions in confined spaces has been recognized for many years. Wellman and Wilson, who stated that for rocks of equal mechanical strength those with large pores separated from each other by microporous regions are most liable to salt weathering. The process is pronounced in desert and coastal areas. It is most likely to be most effective (1) in the humid deserts of western littorals where the supply of salts from fogs and chemical weathering is accompanied by frequent wetting and drying of the surface, and (2) around the margins of playas and along channels in desert areas where salts tend to be concentrated and wetting and drying is most frequent. We accept the effectiveness of salt crystallization pressures, the Salzprengung of German authors, but we suggest that there are two additional factors associated with salts which may lead to the disintegration of rock: (1) stresses exerted by the expansion of many salts in confined spaces as they are heated, and (2) stresses caused by hydration of certain salts in confined spaces.

542. Cooper, G.A. and Arellano, A.R.V. STRATIGRAPHY NEAR CABORCA, NORTHWEST SONORA, MEXICO Amer. assoc, petrol. geologists, bull., v.30 pp. 606-11, 1946 DLC TN860.A3

Caborca, in the heart of the Sonoran Desert, is located in the Altar District. Stratigraphic investigations were conducted in 1943-1944 and are reported. The most gratifying results established a long Paleozoic column including Lower and Middle Cambrian, possibly Ordovician or Silurian, Upper Devonian, Lower and Middle Mississippian, and Middle Permian.

543. Cooper, G. Arthur, A.R.V. Arellano, J.H. Johnson, V.J. Okulitch, Alex Stoyanow, and Christine Lochman
CAMBRIAN STRATIGRAPHY AND PALEONTOLOGY NEAR CABORCA, NORTH-
WESTERN SONORA, MEXICO Smith. Inst., Misc. Collections,
v.119, no.1, August 6, 1952, 184+ pp. DLC Q11.S7.119

This work is concerned strictly with the paleontology and stratigraphy of the area near Caborca. Descriptions of the strata and several columnar sections are presented which prove that the Cambrian is represented by sedimentary rocks in this portion of Mexico. Though restricted as a geologic work, it does include a topographic map and some good photographs of the Arojos Mountains.

544. Craig, Harmon DISCUSSION: SOURCE FLUIDS FOR THE SALTON SEA GEOTHERMAL SYSTEM Amer. jour. sci., v.267, no.2 pp. 249-55, February 1969 DLC Q1.A5

The proposal by Helgeson (1968) that the source fluid for the Salton Sea geothermal brine was interstitial connate Colorado River water in the sediments is evaluated quantitatively in terms of the dynamics of the geothermal system and the isotopic composition of the various waters involved. Neither batch nor continuous evaporation process operating on original interstitial water of present day Colorado River composition can produce the geothermal brine characteristics presently observed. The isotopic evidence indicates that the source fluid was meteoric water derived from local precipitation and circulating downward through the sediments.

545. Craig, Harmon ISOTOPIIC COMPOSITION AND ORIGIN OF THE RED SEA AND SALTON SEA GEOTHERMAL BRINES Science, v.154, no.3756 pp. 1544-48, incl. illus., table, 1966 DLC Q1.S35

Deuterium and oxygen-18 measurements show that the Red Sea and Salton Sea brines are the results of a single process, the leaching of sediments by surface water circulating downward to a geothermal reservoir. The Salton Sea brine is derived from local precipitation but the Red Sea brine originates 1,000 m south of its basin, on the shallow sill which controls the circulation of the Red Sea. On this sill sea water penetrates a thick evaporite sequence to a depth of 2,000 m, and driven by its increased density relative to sea water, flows northward to emerge in the brine-filled deeps.

546. Creasy, S.C. HYDROTHERMAL ALTERATION In: Geology of the porphyry copper deposits, Southwestern North America, ed. by S.R. Titley and C.L. Hicks Tucson, University of Arizona Press, 1966 pp. 51-74, incl. illus., tables, ref.
DLC QE79.5.T55

Strong hydrothermal alteration accompanied the metallization of the Southwest porphyry coppers, but no two deposits are exactly alike. Some common features are described. Experimental data bearing on the alteration are presented, accompanied by graphs showing stability relations and equilibrium curves. Three principal types of alteration are recognized in the porphyries: propylitic, argillic, and potassic. Hydrothermal alteration in nine Arizona districts or deposits is discussed, and summarized in a table.

547. Damon, Paul E. And Michael Bikerman POTASSIUM-ARGON DATING OF POST-LARAMIDE PLUTONIC AND VOLCANIC ROCKS WITHIN THE BASIN AND RANGE PROVINCE OF SOUTHEASTERN ARIZONA AND ADJACENT AREAS Ariz. geol. soc. dig., v.7 pp. 63-78, incl. graph, tables, map, 34 ref., November 1964 DLC unbound

Concerned with K-Ar dating of post-Laramide magmatic rocks in southeastern Arizona and adjoining areas located in the region between $108^{\circ}10'$ to $112^{\circ}10'W$ long. from $31^{\circ}25'$ to $33^{\circ}45'N$ lat. Results from this area will be compared with results for the entire Basin and Range Province. The following conclusions appear to be warranted by present data: (1) during post-Laramide orogeny time, the Basin and Range Province was subjected to a pulse of magmatism. The magmatism began in upper Eocene-lower Oligocene time, reached a peak of intensity at the Oligocene-Miocene boundary, and continued into Pliocene time at a diminishing rate; (2) the composite of Basin and Range magmatic events both during the mid-Tertiary and Laramide orogenies appear to approximately follow a gaussian distribution with a standard deviation of ± 7.5 m.y. The two discrete magmatic episodes are separated by a period of magmatic quiescence during middle Eocene time; (3) in the Pima County area, at least within a circle of 50-mile radius centered in the Sierrita Mountains, magmatism was extremely intense during a span of 3 m.y. or less than 25-28 m.y. ago. The intense magmatism was contemporaneous with the updoming and cooling of the Catalina-Rincon Mountain block (Damon et al., 1963).

548. Damon, Paul E. POTASSIUM-ARGON DATING OF IGNEOUS AND METAMORPHIC ROCKS WITH APPLICATIONS TO THE BASIN RANGES OF ARIZONA AND SONORA In: Hamilton, E.I., and R.M. Farquhar (eds), Radiometric dating for geologists. London and New York, Interscience, pp. 1-77, incl. illus., tables, maps, ref., 1968 DLC QE508.H26

This is a thorough technical review of the K-Ar dating method, decay constants, analytical methods and errors, argon loss, inherited argon, basic assumptions, and interpretive models. The principles developed are then applied to the analysis of age relationships of a wide variety of rocks ranging in age from Precambrian to Cenozoic, with emphasis on the interpretation of metamorphic events. Age data tend to confirm the classic view of discrete orogenic pulses roughly 40 million years apart, separated by periods of quiescence.

549. Damon, Paul E., Richard L. Mauger, and Michael Bickerman K-Ar DATING OF LARAMIDE PLUTONIC AND VOLCANIC ROCKS WITH- IN THE BASIN AND RANGE PROVINCE OF ARIZONA AND SONORA Internatl. geol. cong., 22nd, New Delhi, 1964, proc., Sect. 3 Calcutta, India, International Geological Congress Organising Committee, pp. 44-55, incl. illus., tables, 1964 DLC QE1.I6

Potassium-argon dating of plutonic and volcanic rocks from the Basin and Range Province, primarily in Arizona and Sonora, demonstrates that the most intense Laramide magmatic activity occurs at the Mesozoic-Tertiary boundary. Magmatism is primarily confined to the time encompassed by the Laramie, Fort Union, and Wasatch Formations, that is, a span of 20 m.y., from Maestrichtian through Wasatchian time. The Laramide revolution in the Basin and Range Province constitutes a single, intense pulse which does not appear to overlap the preceding Middle Cretaceous orogeny of the subsequent Middle Tertiary orogeny.

550. Davis, George H. MANAGEMENT OF WATER IN ARID LANDS Nat. hist., v.73, no.7 pp. 26-33, incl. illus., graphs, 4 ref., Aug.-Sept. 1964 QH1.N13

The most complex problems of water supply in arid zones relates to the proper management of the water supply. Problems resulting from inadequate control include salization of water, water logging and hydrocompaction of the soils under irrigation. These conditions, once they have developed, cannot be remedied, or only at great expense, and it is important to control them before damage occurs. Five major items requiring attention are noted: (1) regulation of stream flow by means of reservoirs and water shed management; (2) improvement and maintenance of water quality through adequate control of pollution and contamination; (3) proper use of underground storage; (4) increase in the efficiency of water use through elimination of wasteful irrigation practices and the substitution of low water requirement crops for those with high requirements; and (5) increase of fresh-water supplies by such means as desalinization, weather modification and importation of water from areas of water surpluses.

551. De Meester, T. and J. Bouma THE COLLECTION OF NATURAL SOIL PROFILES FROM ARID REGIONS: A FIELD METHOD AND MANUAL Netherlands jour. agric. sci., v.15, no.1 pp. 63-74, 1967 DLC S11.N53

As a result of experience gained in central Turkey, successful field methods are described for -- the preparation of soil peels of dry, calcareous soils, in particular of clayey soils, and the preparation of soil peels from vertical walls instead of from sloping ones, especially with regard to dry soils. Advice is given on how to transport ready soil peels without damage.

552. Deacon, E.L., C.H.B. Priestley, and W.C. Swinbank EVAPORATION AND THE WATER BALANCE UNESCO, Arid Zone Res., No. 10 pp. 9-34, 207 ref., 1958 DLC QC993.7.U5

After a brief sketch of the characteristics of rainfall in arid regions, the interception of rainfall by trees, the influence of forests on the water balance and the interrelationships of infiltration penetration and run-off, the authors review critically the most important aspects of evaporation and water balance with particular reference to the climatological aspects and to arid regions.

553. Debenham, Frank THE GEOGRAPHY OF DESERTS In: Institute of Biology, The Biology of Deserts. N.Y., Stechart-Hafner, Inc., 1954 pp. 1-6 DLC GB611.I5 1954

The general atmospheric and oceanographic factors giving rise to hot deserts and the specific role of atmospheric moisture in the formation of deserts and the role of rain shadow effect in the formation of the Kalahari and other deserts are summarized and a more detailed account of the moisture cycle in deserts is presented. The formation of convective rain in deserts, the effect of dark bare soil on thunderstorm and rainfall incidence in the Kalahari, rainfall infiltration into desert soil, etc., are discussed.

554. DeMastus, H.L. PRESSURE DISTURBANCES IN THE VICINITY OF DUST DEVILS Amer. meteorol. soc., bull., v.35, no.10 pp. 497-99, Dec. 1954 DLC QC851.A6

The meteorological conditions associated with the appearance of three dust devils on April 17, 1954 at Phoenix, Arizona are described. A microbarograph record taken during the occurrence of the dust devil is reproduced. A sudden fall in pressure was recorded with the passage of the dust devils.

555. DESERT RESEARCH PROCEEDINGS. INTERNATIONAL SYMPOSIUM HELD IN JERUSALEM, MAY 7-14, 1952, SPONSORED BY THE RESEARCH COUNCIL OF ISRAEL AND THE UNITED NATIONS EDUCATIONAL, SCIENTIFIC, AND CULTURAL ORGANIZATION Jerusalem, Research Council of Israel, Spec. pub. no.2, 1953 641 pp. DLC GB611.D4 1952

This collection of papers examines the scientific aspects of problems common to arid and semiarid regions. Dry climates are described and the characteristics of soils in arid regions are set forth. The ecology of plants and animals of dry regions, the action of wind and dunes, water balance, dew, radiation, evaporation, explorations for ground water, irrigation sciences, and other related topics are discussed by experts.

556. Dibblee, T.W. Jr. AREAL GEOLOGY OF THE WESTERN MOJAVE DESERT, CALIFORNIA US Geol. Survey, Prof. Paper 522, 153 pp., incl. illus., tables, map. 1967 DLC QE79.P9

Rocks of the desert region and bordering mountains are divided into three groups: (1) pre-Tertiary crystalline rocks, consisting of dynamothermal metamorphic rocks, metasedimentary rocks, hypabyssal and metavolcanic rocks, and plutonic rocks; (2) Tertiary sedimentary and volcanic rocks, and (3) Quaternary sediments and local basalt flows, mainly alluvial deposits that rest unconformably on Tertiary and pre-Tertiary rocks. The structure of the metamorphic rocks is complex and structural trends are erratic. The western Mojave Desert region is a tectonic block -- the Mojave Block -- which is bounded by the San Andreas fault and the Garlock fault zone, and is broken by several major high-angle faults. The major domestic sources of boron compounds is a single large deposit of sodium borate in middle Miocene lacustrine shale.

557. Dickson, Bertram T. GUIDE BOOK TO RESEARCH DATA FOR ARID ZONE DEVELOPMENT Paris, UNESCO, Arid Zone Research No. 9 1957 191 pp., incl. illus., tables, ref. DLC GB611.D5

"At its fifth session, the Advisory Committee for Arid Zone Research, recommended that UNESCO publish a volume which would present the broad requirements of each part of a study needed to make an integrated survey of any area on the semi-arid to arid zone." Each chapter is devoted to "the basic requirements of each survey and it presents the material with a minimum of technical detail."

558. Dickson, B.T. CHALLENGE OF ARID LANDS Science monthly, v.82,
no.2 pp. 67-74, February 1956 DLC Q11.P3

The problems encountered in the development of arid lands are discussed under the following headings: water, soils, plants, animals, man and power sources. The section on water contains a discussion on the feasibility of artificial precipitation for increasing the water resources of arid regions, evidence for climatic change in Tunisia and for climatic stability in Palestine during historical time, measurement of evapotranspiration in semiarid and arid regions with special reference to the technique of C.W. Thornthwaite, studies of underground water such as that carried out in the Thal Desert area in Pakistan, and the utilization of saline water. The needed areas of soil research for semiarid and arid regions as outlined by Charles E. Kellog are quoted. The physiology of desert plants, physiological stress exerted by desert temperatures on man and the use of wind and solar energy as power sources are reviewed briefly.

559. Dill, D.B. et al SWEAT ELECTROLYTES IN DESERT WALKS Jour.
appl. physiol., v.23, no.5 pp. 746-51, 1967
DLC QP1.J72

The rate of sweating in desert walks at 80 or 100 m/min. and the concentrations of Na, K, and chloride in sweat were studied in 31 school boys, the same number of school girls, in several men, and in 2 women. The rate of sweating under such conditions even up to an ambient temperature of 42°C depends on body surface, metabolic rate, and ambient temperature, not on sex nor age. The sweat produced is all evaporated; there is equal water economy irrespective of age and sex. An individual exhibits a wide range in composition of sweat depending on the internal and external environment. Also there is a wide intra-individual range in the same external environment and at the same metabolic rate.

560. DISTRIBUTION OF ARID CLIMATES UNESCO Courier, v.5, no.7
pp. 7-9, July 1952 DLC AS4,U8A14

A world map of arid zones prepared by Dr. Peveril Meigs, chairman of the Arid Zone Committee, International Geographical Union, Washington, is reproduced in a slightly simplified form. "Extreme arid," "arid" and "semi-arid" zones are distinguished on the map and definitions of these terms given. The usefulness of such a map and some features of the distribution of arid climates are discussed.

561. Doe, B.R., C.E. Hedge and D.E. White
PRELIMINARY INVESTIGATION OF THE SOURCE OF LEAD AND STRONTIUM
IN DEEP GEOTHERMAL BRINES UNDERLYING THE SALTON SEA GEOTHER-
MAL AREA Econ. geol., v.61, no.3 pp. 462-83, incl.
illus., table, 1966 DLC QE1.E15

Lead and strontium isotope ratios in metal-rich geothermal brines are compared to those of rhyolite glass from near-
by rhyolite domes and also to those from Tertiary and
Quaternary sediments of the area. "The isotopic data in-
dicate that 80-100 percent of the strontium and 50-100 per-
cent of the lead in these brines were acquired from the
associated sediments" rather than from the rhyolite. The
ratios fro strontium suggest that the rhyolite cannot be
derived wholly from melting of sediments like those sampled.

562. Dorroh, John H., Jr. BENEFICIAL USE OF WATER IN ARID LANDS
In: Gilbert F. White (ed.), The Future of Arid Lands.
Wash. D.C., American Association for the Advancement of
Science, 1956 pp. 156-60, incl. ref.
DLC GB665.A55

A summary of the results of a study carried out in Arizona,
Colorado, New Mexico and Utah to determine: (1) the aver-
age annual precipitation, (2) the part of the original sup-
ply of precipitation available for irrigation and other
uses, (3) the watershed and climatic factors predominant
in the production of water yield, and (4) possible measures
for reducing water losses to non-beneficial use.

563. Dubief, Jean STUDY OF THE SURFACE HYDROLOGY OF THE SAHARA
 (Essai sur l'hydrologie superficielle au Sahara) Algiers
 Direction du Service de la Colonisation et de l'Hydraulique,
 Service des Etudes Scientifiques, 1953 457 pp., incl.
 illus., tables, maps, ref. DWB

An important advance for hydroclimatic exploration of the Sahara Desert. Detailed discussion is devoted to rainfall conditions with a mathematical frequency analysis of annual precipitation, giving also for separate stations the number of years without or almost without rain, mean rainfall and its variability, rainfall intensity, frequency and seasonal variation. The source of precipitation is discussed from the viewpoint of dynamic climatology, showing the southern limit of monsoon rainfall. Most of the rainfall is connected with depressions coming from equatorial regions. Sample maps show typical rainfall distribution in the different seasons. Some remarks are made on snow in the Sahara. Evaporation from free water surfaces and from soil is commented on. Very detailed summaries characterize each basin, from the topographical view with maps of the basins and comparing the seasonal frequency and duration of flash floods with the frequency of rainfall. The soil moisture relations are briefly analyzed and the effect of the floods on the economic development is described. For the relation between the annual precipitation and runoff the equation $R/mm = 0.75 (P-8)$ is adopted, which was found by Sutton for Egypt. A detailed map (1:10,000,000) shows the distribution of annual rainfall north from 4°N, others the main basins and the location of areas where surface runoff occurs.

564. Duisberg, Peter C. DESERT PLANT UTILIZATION Texas jour. sci., v.4, no.3 pp. 269-83, incl. illus., 1952
DLC Q1.T4

A discussion of desert plants of actual or potential economic importance, with pertinent chemical and industrial data. Some plants considered for specific chemical components are: wax -- Euphorbia antisyphilitica and Simmondsia chinensis; fiber -- Nolina microcarpa, Agave sp., Yucca sp.; antioxidant -- Larrea divaricata; tannin -- Rumex hymenosepalus; rubber -- Parthenium argentatum; oil -- Cucurbita foetidissima, C. digitata, C. palmata, and Martynia parviflora; gum -- Prosopis juliflora and Opuntia sp.

565. Dumble, Edwin T. NOTES ON THE GEOLOGY OF SONORA, MEXICO Amer. Inst. Mining Engineers, trans., v.29 pp. 122-52, 1900 DLC TN1.A5

Describes the occurrence of Cambrian, Silurian, Carboniferous, Jura-Trias, Cretaceous, and Tertiary rocks of the region.

566. Duncan, K.D. EFFECTS OF AN ARTIFICIAL ACCLIMATIZATION TECHNIQUE ON INFANTRY PERFORMANCE IN A HOT CLIMATE Ergonomics, v.9, no.3 pp. 229-44, 1966 TA166.E7

The experimental group was subjected to an artificial acclimatization routine consisting of physical exercises in an improvised hot chamber. The control group performed the same exercises in a room of similar proportions at ambient temperatures. After approximately 2 weeks of these training regimes, the company was immediately flown to Aden where its performance under considerable stress was assessed during a 7 day exercise in the desert. Of 8 performance tests, only 3 indicated beneficial effects of artificial acclimatization. The most impressive difference between the 2 groups was in the number of casualties. Casualty incidence was 3 times greater in the control group, both for heat casualties and for all casualties regardless of the disorder diagnosed.

567. Dutcher, Lee C. and J.S. Bader GEOLOGY AND HYDROLOGY OF AGUA CALIENTE SPRING, PALM SPRINGS, CALIFORNIA US Geol. Sur. Water-supply paper 1605, 43 pp., incl. illus., tables, 8 ref., 1963 DLC TC801.U2

Agua Caliente Spring, on land belonging to the tribe of Agua Caliente Indians, flows from a low mound that rises only a few feet above the nearly featureless alluvial plain of Coachella Valley. The temperature of the water is about 107°F, and the total flow is about 25 gpm (gallons per minute). Near the spring the granitic rocks of the basement complex, that are exposed in the San Jacinto Mountains just to the W, are moderately to highly fractured. The evidence indicates that precipitation on the mountains to the W is the source of the water discharged at the spring. The geologic and hydrologic setting of the spring, although probably not unique, is very interesting and well documented by ground-water data. The orifice and peripheral spring deposits probably were progressively washed to the surface by thermal spring water rising through the alluvial deposits. The finer grained parts of the alluvium may have been the source of most of the deposits of the spring mound, but part may have been derived from fine materials in fractures in the crystalline rocks which underlie the alluvium or from material blown into the spring area. However, mechanical analyses and microscopic examination suggest that virtually none of the deposits are windblown sand. It is thought that fine silty sand was carried to the surface by the hot-spring water and during the Recent epoch at least, accumulated at a rate sufficient to maintain a low mound that probably was constantly higher than the surrounding surface of the alluvial fan. The finer deposits were washed to the margin of the spring mound where they formed an effective chimney of very low permeability around the vertical conduits of permeable washed sand through which the water rose to the surface. No evidence of a calcareous or other cemented chimney surrounding the spring orifice was observed during the extensive excavation to a depth of 12 ft at the site, but cementation may occur at depth.

568. Edney, E.B. ANIMALS OF THE DESERT In: E.S. Hill (ed.), Arid lands; a geographic appraisal. London, Methuen, 1966, pp. 181-218, incl. illus., tables, 62 ref. DLC GB611.H5

To treat this vast topic briefly, the approach is to consider the peculiar problems presented by the desert environment, to derive general principles as far as this is possible and to illustrate and amplify these by examples. The general problems are those facing all terrestrial (as opposed to

aquatic) animals, so that these are best adapted for desert life. Mammals, reptiles, birds, insects and arachnids include nearly all the inhabitants of deserts. Water and temperature relationships are discussed generally and then in special relation to arid areas. The camel is discussed as an example of a large mammal. Many other examples of small mammals, birds reptiles and insects are discussed. The chapter concludes by discussing animal populations and phenology. When cultivated, arid areas are very vulnerable to pests. Yet equally well-adapted desert animals could be exploited by man to a greater extent than at present.

569. Edney, E.V. THE SURVIVAL OF ANIMALS IN HOT DESERTS Smithsonian Institution, Rept. for 1959, pub. 1960, pp. 407-25
DLC Q11.S66

This paper considers the difficulties which confront animals living in hot dry environments, and tries to explain why some are more successful than others in overcoming them. Topics discussed include: respiration, nitrogen excretion, transpiration, temperature control, water economy, the desert environment, and mammals and arthropods of the desert.

570. Edwards, Elza Ivan DESERT HARVEST Los Angeles, Westernlore Press, 1962, 128 pp. DLC Z1251.S8E3

Twenty-five books are listed and given highly individualized commentary by the author. Approximately half the books listed were published before 1925; ten of the books are original source accounts such as field reports, diaries, journals and the like, the remainder are considered to be reference or "reference-narrative" works.

571. Edwards, Elza Ivan DESERT VOICES: A DESCRIPTIVE BIBLIOGRAPHY Los Angeles, Westernlore Press, 1958, 215 pp.
DLC Z1261.E33

An extensive bibliography with personalized comments on the southwest deserts that includes a fair amount of scientific items, but is strongest in personal travel accounts and historical works.

572. Eichna, Ludwig W., Cahrlles R. Park, Norton Nelson, Steven M. Horvath and Edward D. Palmes
THERMAL REGULATION DURING ACCLIMATIZATION IN A HOT, DRY (DESERT TYPE) ENVIRONMENT Amer. jour. physiol., v.163, no.3 pp. 585-97, 1950 DLC

Three healthy young men performed 1 hour of standard work on a treadmill daily; first for 9 days in a cool environment (D.B. 78°F, W.B. 62°F) then for 10 days in a hot, dry environment (D.B. 123°F, W.B. 80°F) and finally for 2 days in the initial cool environment. Observations were made of: (a) heat content of the body and heat distribution in the deep and peripheral tissues; (b) heat interchanges between man and his environment, partitioned into metabolism, convection, radiation and evaporation and (c) flow of heat within the body as detd. by the "peripheral blood flow." The acclimatization process returned the initially (1st day) elevated deep tissue (rectal) temp. to the level originally shown in the cool environment, and lowered somewhat the initially high peripheral tissue (skin) temp. but did not return it nearly to the level in the cool. Skin temp. appeared to be adjusted to a new level, which permitted thermal equilibrium between the body and the environment on one hand, and on the other, permitted a more efficient transport of deep heat to the periphery, with the result that the circulation was not overtaxed as it had been on day 1 in the heat. The principal adaptive mechanism was an increase of 10% in sweat secretion above that on the first day in the heat. The resultant increase in evaporative cooling accounted for 75-90% of the reduction in body temp. and heat content. Metabolic heat production decreased by a mere 4% and accounted for only 5-20% of the reduction in body heat content. Due to the lowering of skin temp. by the increased evaporative cooling, heat gains by convection and radiation actually increased (+8%) as acclimatization developed and this necessitated twice as large an increase in sweat secretion as would have been required had the skin temp. not fallen. However, the lower skin temp. widened the internal thermal gradient so that 70% of the initial "peripheral blood flow" sufficed to transfer the metabolic heat from the deep tissues to the periphery and to that extent spared the circulation.

573. Elston, R.N. DESERT RESEARCH Sci. news, v.27 pp. 7-29, 1953

Relation of deserts to rainfall and evaporation is summarized, with a section on desert climatology and climatic classification. A recorded air temperature of 148° in NW Pakistan is quoted. Other sections deal with wind-blown sand, hydrology, plants, soils and ecology, effective rainfall (months with P/E 1/3) and windbreaks. Russian development schemes are described.

574. Erickson, Carl R. ARIZONA CLIMATE Arizona Highways, v.28, no.3 pp. 3-7, 38-39, March 1952 DLC TE24.A6A87

The territory of Arizona is divided into three climatic regions; the northeastern high plateau, eroded canyons and valleys in the central belt, and deserts in the southwest. Climatic features of the region including temperature, pressure, upper air circulation, storms, precipitation, humidity and runoff are described and examples given. A table of temperature, precipitation and humidity data for 7 stations, taken from 3- to 70-year averages is presented. Photographs show characteristics of the different regions.

575. Eriksson, E. THE CHEMICAL CLIMATE AND SALINE SOILS IN THE ARID ZONE UNESCO Arid Zone Res., No. 10 pp. 147-80, incl. illus., tables, 81 ref., 1958 DLC QC993.7.U5

A comprehensive review of present knowledge of the role of the atmosphere in the circulation of sea salts, the distribution of sea salt components over continents and the chemical climate of arid zones. The contents of this paper include the transport of sea salts into arid regions, namely Mexico and southwestern United States, arid regions of South America, the Sahara region south of the Sahara Desert, southwest Africa, northwest India, Australia, arid regions of the Near East, Central Asia and in oceanic islands in the subtropical belts; chemical hydrology, and the role of atmospheric salts in soil formation.

576. Evans, James R. FALLING AND CLIMBING SAND SUNES IN THE CRONESE ("CAT") MOUNTAIN AREA, SAN BERNARDINO COUNTY, CALIFORNIA
Jour. geol., v.70, no.1 pp. 107-13, incl. illus., Jan. 1962, 12 ref. DLC QE1.J8

Sand-draped Cronese ("Cat") Mountain projects NE to nearly join the NW-trending Soda Mountains, and separate the adjacent Cronese Valley into E and W, but interconnecting, playas. Each playa contains a dry lake. Beach sand deposited during the highwater stand of old Lake Cronese (Little Lake Mojave) is source material for climbing and falling dunes. Prevailing westerly winds have driven available sand in the W Cronese playa upon the NW slope of Cronese Mountain, over the ridge (locally as much as 900 feet above the playa), and down the SE slope to form falling dunes. On both sides of the mountain, sand has sifted into talus cones and covers both bedrock and alluvial fan debris but deposits are thicker on the windward slope than on the leeward slope. Many sand surfaces are rippled by winds of minor velocity. Prevailing wind direction was determined by a study of the "tails" wind-shadow dunes on the lee side of vegetation. Six sand dunes, 3 climbing and 3 falling, were studied in detail; all are on the NE part of the mountain.

577. Ewan, J. BIBLIOGRAPHY OF THE BOTANY OF ARIZONA Amer. midland naturalist, v.17 pp. 430-54, 1936
DLC QH1.A35

Arranged in chronological order, these 208 references emphasize the taxonomic and floristic works. Approximately half the references cover the period up to 1907. Annotated with geographical and author indexes.

578. Humphrey, Robert R. FIRE AS A MEANS OF CONTROLLING VELVET MESQUITE, BURROWEED, AND CHOLLA ON SOUTHERN ARIZONA RANGES
Jour. range mgmnt., v.2, no.4 pp. 175-82, Oct 1949, 11 ref. DLC SF85.J67

Two areas near Tucson were burned in 1933, and counts on burned and adjacent unburned range were made in 1935. In both areas Bouteloua rothrockii (Rothrock grama) increased, while burroweed, Aplopappus temuisectus was greatly reduced by the fire. A re-examination of the areas 15 yrs. after they were burned, revealed one (a long, narrow burn) re-invaded by velvet mesquite (Prosopis velutina). The other area, considerably wider, was still relatively free of burroweed and other shrubs killed by the fire. This study

supports earlier beliefs of Thornber (1907, 1910), Cook (1908), and Griffith (1910), and of Wootton (1916), and points to fire as a possible effective and economical agent in the control of some noxious range plants in the Southwest.

579. Melton, Mark A. THE GEOMORPHIC AND PALEOCLIMATIC SIGNIFICANCE OF ALLUVIAL DEPOSITS IN SOUTHERN ARIZONA Jour. geol, v.73, no.1 pp. 1-38, incl. illus., tables, graphs, maps, 55 ref., January 1965 DLC QE1.J8

Alluvial deposits in Southern Arizona are grouped for geomorphic-climatic interpretation. Oldest group consists of continental sediments and volcanic rocks deposited under conditions of crustal instability and subhumid climate prior to Basin and Range orogeny; and moderately tilted, faulted, coarse, postorogenic fanglomerates deposited during rapid erosion of uplifted mountain blocks under hot semiarid climate. A second group consists of locally deformed, fine-grained lake beds and correlative deposits, deposited from lower Pliocene to middle Pleistocene under generally mild climates. A third group consists of fan deposits that were the product of rapid mechanical weathering during cold glaciopluvial stages. The fourth group consists of fine-grained, cienega beds, deposited from 500 B.C. to about A.D. 1800 in almost every watercourse under a climate very much like today's.

580. Paylore, Patricia DESERT RESEARCH, II: SELECTED REFERENCES 1966-1970 Technical Report 71-20-ES, US Army Natick Labs, Natick, Mass., Sept. 1970, 169 pp.

This Report consists of 594 references to worldwide desert literature appearing between 1966 and 1970, and not included in the previous bibliography (ref. 7). The permutation index used previously has been replaced by a general subject index. (5 references were extracted for this study.)

581. Paylore, Patricia, and W.G. McGinnies DESERT RESEARCH: SELECTED REFERENCES Tech. Report 70-24-ES US Army Natick Labs, Natick Mass., Dec. 1969, 410 pp. AD 703 884; CFSTI

Report consists of a selection of 1,094 references to worldwide desert literature for 1965-1968, together with an appendix of 385 references published before 1965, with emphasis

on vegetation, fauna, geomorphology and surface hydrology, weather and climate, surface materials, geohydrology, regional geography, and desert coastal areas as well as a limited number dealing with various aspects of the human, cultural, economic and political geography of deserts. Titles permitted to provide an index if significant key-words. (18 abstracts)

582. Fair, C.L. PROBABLE CRETACEOUS-TERTIARY SECTION IN FRESNAL CANYON, BABOQUIVARI MOUNTAINS Ariz. geol. soc. dig., v.4, pp. 93-94, Nov. 1961 DLC unbound

A large section of Cretaceous and/or Tertiary rocks occurs in Fresno Canyon, in the Baboquivari Mountains, Pima County. These rocks dip steeply westward and are apparently in normal stratigraphic sequence. Bedding faults may modify the sequence locally, but the local effect is believed to be small. Aggregate thickness of the section is about 15,000 ft.

583. Fernald, Arthur T., and others SURFICIAL DEPOSITS OF YUCCA FLAT AREA, NEVADA TEST SITE In: Nevada Test Site, Geol. Soc. Amer. Memoire 110, pp. 49-55, 1968, incl. illus.

Yucca Flat is underlain by coalescing colluvial-alluvial fans, developed where minor streams emerge from the mountains, and alluvial fans formed by major streams. The first, rubble mixed with gravel, reflects adjacent bedrock and in places merges upslope into talus. The second, largely coarse gravel on the piedmont, becomes finer-grained in the lowland, grading into playa deposits of Yucca Lake. Most fans are of Recent age; some terraces and dissected fans are probably late Pleistocene. Older Quaternary and Tertiary deposits, thick conglomerates in some places, thin pediment deposits in others, collectively contain boulder to pebble sized gravel, rubble and sand. The conglomerates were now deeply dissected, but their distribution indicates that broad aprons once bordered the mountains.

584. Finkel, Herman J. THE MOVEMENT OF BARCHAN DUNES MEASURED BY AERIAL PHOTOGRAMMETRY Photogramm. engng., v.27, no.3 pp. 439-44, incl. illus., tables, June 1961, 2 ref. DLC TA593.A2P5

Field measurement of 45 barchan dunes of the Pampa de la Joya, Peru, indicated the following linear relationship

between width (W) and crest height(H), in meters: $W=10.3H + 4.0$. The width (W) is measured across the horns of the dune at right angles to the wind direction. Various factors, including annual displacement or movement of dunes exhibiting different crest heights, were determined by employing photogrammetric techniques. Annual displacement ranged from approximately 30 m for dunes with crest heights of 1 m, to 9 m of displacement for 7-m dunes. Greater concentrations of barchans were noted toward the upwind end of the study area and average distribution density decreased downwind. The decrease in dune density downwind appeared to be the result, primarily, of the lateral spreading of approximately the same number of barchans over a progressively wider area. If a mathematical analysis of the size-distribution of barchans over the entire area is made, it may be possible to calculate the minimum period of time required for the achievement of the present configuration. This would permit the dating of climatic changes in post-Quaternary time.

585. Flach, Klaus W., and Guy D. Smith THE NEW SYSTEM OF SOIL CLASSIFICATION AS APPLIED TO ARID-LAND SOILS In: Arid lands in perspective, ed. by Wm. G. McGinnies and B.J. Goldman Washington, American Association for the Advancement of Science, 1969 pp. 61-73, incl. tables, illus., 10 ref. DLC S613.A7

Classes in the new comprehensive system of soil classification (7th Approximation) consist of soils of similar genesis that occur as natural units in the landscape. Although based on genetic and geographic relationships, the definitions of classes are in terms of morphological, chemical, and physical soil properties. Major soil-forming processes, such as the accumulation of organic matter or of clay, are reflected in diagnostic surface or subsoil horizons that are used repeatedly in the definitions of taxa. The system has 7 categories with 10 orders at the highest and some 8,000 soil series at the lowest level. Names of taxa were coined primarily from classical roots. Developed soils in arid lands are mostly in the order ARIDISOLS. ARIDISOLS with horizons of clay accumulation are in the suborder ARGIDS; those without, in the suborder ORTHIDS. The presence or absence of pan horizons, sodium saturation, salinity, organic matter content, soil texture, mineralogy, and soil temperature are among the criteria for classes at lower categories.

586. Fletcher, Joel E. and Gordon L. Bender SYMPOSIUM ON ECOLOGY OF GROUNDWATER IN THE SOUTHWESTERN UNITED STATES, ARIZONA STATE UNIVERSITY, TEMPE, APRIL 18-19, 1961 Tempe, Ariz. Arizona State University, 1965, 74 pp. DAS M79.5S986s

Five general papers with introduction and summary by Joel E. Fletcher, deal with occurrence and sources of groundwater, natural and artificial recharge, analog-computing in arid-zone hydrology, and with geophysics in groundwater studies. Some conclusions reached are: the Southwest will continue to depend on groundwater for a large part of its water for a long time to come. Removing riparian vegetation or phreatophytes appear to be the only feasible way the hydrologic cycle can be altered to improve groundwater recharge. The success of geophysical exploration methods is limited by contrasts in physical properties and by the geometry of the geologic situation and the skill of the operator.

587. Foulk, J.D. DRAINAGE OF A DESERT SPRING CREEK FOR CONTROL OF LEPTOCONOPS KERTESZI (Diptera: Ceratopogonidae) Mosquito news, v.26, no.2 pp. 230-35, 1966 DLC RC116.M67

This anthropophilic gnat has been found breeding in damp sandy soils in many areas of Southern California, especially in Eastern Riverside County near the Salton Sea. Natural moisture of the breeding ground was 10-13%, and gnats were eliminated when soil moisture was reduced to 5% or less.

588. France, Centre National de la Recherche Scientifique WIND EFFECTS AND PHENOMENA OF EVAPORATION AND OF SURFACE HYDROLOGY IN ARID REGIONS, ALGIERS, MARCH 27-31, 1951 (Actions eoliennes phenomenes d'evaporation et d'hydrologie superficielle dans les regions arides, Alger, 27-31 Mars 1951) Its: Colloques Internationaux, no.35, 1953 372 pp., incl illus., tables, ref. DWB M56 F815ac

The book consists of three parts: (I) Wind effects deals with mobile sands of North Africa and means of sand drift prevention; (II) Various problems related to dunes and soils discusses granulometric and microscopic studies of sand varieties, classification of sand minerals, immobilization of dunes and other surface phenomena in arid regions; (III) Evaporation and surface hydrology describes the streams of the Sahara, devices and methods for measuring evaporation and the motion of ground water under effect of temp.

589. Fregly, H.J. and P.F. Iampietro DIETARY POTASSIUM SUPPLEMENTATION AND PERFORMANCE IN THE DESERT US Army QR&E Center, Natick, Mass., Tech. rept. EP-109, April 1959, 21 pp., 15 ref. PB 142 310: Order from LC, mi \$2.70; ph \$4.80

590. Freile, A.J., and T.A. Leavy A SIMPLIFIED METHOD FOR DETERMINING THORNTWHAITE CLIMATIC CLASSIFICATIONS Prof. geographer, v.19, no.5, pp. 244-46, 1967 DLC G3.P7

One of the most rational climatic classification systems available was developed by Thornthwaite, but many geographers are reluctant to use it because of the apparent mathematical complexities which it involves. The purpose of this paper is to outline a method of classification whereby one needs to use almost no mathematics. In place of complex formulas, the authors have substituted simplified graphs, tables, and charts (available from Leavy, c/o Dept. of Geography, California State College, California, Pennsylvania).

591. Fries, Carl Jr. SKETCH OF THE GEOLOGY OF THE STATE OF SONORA, WITH SPECIAL REFERENCE TO THE PALEOZOIC (Resena de la geologia del estado de Sonora, con enfasis en el paleozoico) Text in Spanish. Assoc. Mes. geol. petrol. bol., v.14, no.11/12 pp. 257-73, Nov/Dec 1962, 54 ref. DLC QE1.A73

The pre-Paleozoic basement of the State of Sonora (Mexico) is a middle Precambrian metamorphic complex with a minimum age of 1700 m.y. which was deformed and intruded by plutonic rocks during the so-called Mazatzal Revolution. It is overlain with angular unconformity by a succession of slightly metamorphosed upper Precambrian sedimentary rocks which locally is as much as 2000 m thick. Slight tectonic movements and erosion affected the basement before the beginning of deposition of Paleozoic clastic and carbonate sediments. Paleozoic rocks include portions of all systems from Cambrian (beginning with Lower Cambrian in the northwestern part of the state) to Permian, separated by numerous hiatuses. The sedimentary composition and stratigraphic characteristics during the Late Cambrian and all of the Paleozoic suggest that the region represented a continental platform or miogeosyncline for which the name Sonoran Trough (Fosa Sonorana) of the North American Geosyncline is proposed. The presence of angular unconformities with the

overlying rocks and a complete change in the pattern of sedimentation in the Late Triassic suggests a tectonism in the latter part of the Paleozoic and beginning of the Mesozoic which is now called the Sonoran Orogeny. Mesozoic sedimentation began late in the Triassic and continued with interruptions through the Jurassic and Cretaceous. The sediments which were deposited were mainly clastic materials with an increasing admixture of volcanics. The thickness of the Mesozoic section is unknown, although locally it exceeds 3000 m. Marine sedimentation appears to have concluded before the end of the Cretaceous and was not renewed.

592. Fritschen, Leo J. and C.H.M. van Bavel ENERGY BALANCE COMPONENTS OF EVAPORATING SURFACES IN ARID LANDS Jour. geophys. res., v.67, no.13 pp. 5179-85, incl. tables, figs., 5 ref., Dec. 1962 DLC QC811.J6

The components of the surface energy balance equation $R_n + S + (S' \text{ or } W) + LE + A = 0$ were determined during April and May 1961 in experiments conducted over an extended wet, bare soil surface and over an extended area of shallow water in the vicinity of Phoenix, Ariz. Evaporative flux (LE) measurements were found from sensitive weighing lysimeters. Net radiation (R_n) was measured with miniature net radiometers. Soil heat flux (S) was measured with heat-flow transducers. The change of energy storage of the layer of soil (S') or water (W) above the heat-flow transducer was computed using direct measurements of soil or water temperature. The sensible heat flux into the air (A) was determined by solving the energy balance equation. The results of triplicate measurements made every 15 minutes for nine consecutive days indicate that the daily totals of the sensible heat flux to the air were generally negative, i.e., away from the surface. The rate of evaporation was larger from a wet soil surface than from a free water surface. On days of similar solar radiation, the evaporative flux tended to be correlated with wind speed.

593. Gates, David M., Ronald Alderfer and Elwynn Taylor LEAF TEMPERATURE OF DESERT PLANTS Science, v.159, no. 3818 pp. 994-95, incl. table, graph, 3 ref., March 1968 DLC Q1.S35

Temperatures of small leaves of many desert plants are within 30°C of air temperature in contrast to the temperature of Opuntia in the same locale; this plant has a temperature 10°-16°C above air temperature. Theoretical justification for the observation is given based on an energy budget analysis.

594. Gehlbach, Frederick R. PLANT FORMATIONS IN THE NATURAL HISTORY INTERPRETATION OF SOUTHWESTERN DESERT REGIONS Natl. parks mag., v.40, no.1 pp. 16-18, incl. illus., table, Jan. 1966 DLC SB482.A466

The Chihuahuan Desert is neither a geographic region nor a life zone, but rather a plant formation or a biome if plants and animals are both included. Dominated by shrubby leaf-succulent or semi-succulent species like lechuguilla and narrowleaf sotol, it occupies the dry, rocky hillsides in western Texas, southern New Mexico, and northern Mexico. There are 11 different plant formations in "hot desert" regions of the Southwest. The Sonoran Desert is equally distinctive in characterizing a single geographic region. Its dominant species are trees like saguaro and foothill paleoverde together with such shrubs as cholla and brittlebush. The Sonoran and Chihuahuan deserts occupy similar environmental positions -- foothill and bajada slopes -- in their respective regions but are dominated by very different plant forms -- stem succulent cacti either of tree or shrub size on the one hand, and leaf-succulent or semi-succulent shrubs on the other.

595. Gile, Leland H. COPPICE DUNES AND THE ROTURA SOIL Soil sci. soc. amer., proc., v.30, no.5 pp. 657-60, incl. illus., 1966 DLC S590.S64A13

Certain coppice dunes near Las Cruces, New Mexico, appear to have formed since 1885. The Rotura soil, formed in mid-Pleistocene sediments, is exposed between dunes but buried beneath them. The dunes overlie and preserve the pre-dunes surficial horizons, and their stratigraphic relationships can be useful in genetic studies of thin upper horizons between dunes. Coppice dune materials are not presently recognized as individual soils but are designated by such terms as "hummocky phase"; with no apparent A or B zone development, roots and fauna have locally mixed the sediments. The coppice dunes dominate the microrelief and occupy major portions of the land surface in many areas, most of them thickly covered with vegetation. An alternative interpretation is that their sediments constitute a soil and should be classified.

596. Gilead, M., and N. Rosenan CLIMATOLOGICAL OBSERVATIONAL REQUIREMENTS IN ARID ZONES UNESCO Arid Zone Res., No. 10 pp. 181-88, incl. tables, ref., 1958 DLC QC993.7.U5

In arid lands where long observation periods and well distributed networks are absent, special requirements arise for making climatological observations. The first on climatology in arid zones will be the intensification and normalization of climatological networks on the fringes of deserts. For the investigation of regional climates with a view to their classification and climatic fluctuations, short term climatological stations and rainfall stations within an area having at least one basic climatological station could be established. Where this is impossible pedological, ecological and archaeological evidence can be used to determine climatic characteristics. For the study of local climates (topoclimatology) observational requirements differ from the basic climatological and rainfall networks. the elements to be observed at climatological stations in arid zones are listed in a table, and notes explaining the application of climatological instrumentation in arid zones are presented.

597. Ginzburg, Chen XEROPHYTIC STRUCTURES IN THE ROOTS OF DESERT SHRUBS Ann. bot., n.s., v.30, no.119 pp. 403-19, 1966 50 ref. DLC QK1.A47

The influence of dry and salty habitats on root structure of 30 species in the Negev is studied. Statistically significant structural differences could be related to environment: for example, extreme hydro and xerohalophytics develop wide casparian strips in their epidermis.

598. Green, Christine R. ARIZONA STATEWIDE RAINFALL Ariz. Univ. Inst. Atmos. Phys., Tech. repts. on the meteorology and climatology of arid regions, No. 7, Nov. 30, 1959, 14 pp., incl. maps DWB

A statistical method of deriving a statewide average annual precipitation value for Arizizona has been developed in this study. The technique employed and several examples showing how these calculations may be used to determine any given year's average rainfall amount for the state or for any smaller state subdivision are presented.

599. Guild, W.R. NOTE ON HEAT TRANSFER AT THE SOIL SURFACE Jour. meteorol., v.7, no.2 pp. 140-44, April 1950, 12 ref. DLC QC851.A283

Heat balance and eddy diffusion as determined from data obtained at night under desert conditions (in Arizona). Marked correlation exists between eddy diffusivity and wind speed. Convective term accounts for as much as half of the net transfer; hence cannot be ignored.

600. Hadley, R.F. PEDIMENTS AND PEDIMENT-FORMING PROCESSES: SHORT REVIEW Jour. geol. ed., v.15, no.2 pp. 83-89, 1967 DLC QE40.J6

The wide divergence of opinion among geomorphologists regarding origin of pediments and processes involved is emphasized, and points of general agreement are noted. Climatic factors best suited for pedimentation are considered and hypotheses proposed for their formation are discussed.

601. Hamiltin, W.B. GEOLOGY OF THE COLORADO DESERT (SALTON TROUGH) Calif. Div. Mines and Geol., Mineral inform. service, v.22, no.6 pp. 96-98, incl. illus., 1969 DLC HD9506.U63C35

Reprinted with illustrations, this paper was published originally in US Cong., 89th, 2d Sess., Comm. Interior and Insular Affairs, Comm. Print (California Div. Mines and Geology Bull. 191), p. 73-76, 1966.

602. Hamilton, Warren GEOLOGIC MAP OF THE BIG MARIA MOUNTAINS NE QUADRANGLE, RIVERSIDE COUNTY, CALIFORNIA, AND YUMA COUNTY, ARIZONA US Geol. Survey, Geol. Quad. Map GQ-350, scale 1:24,000, lat. $33^{\circ}52'30''$ - 34° N, long. $114^{\circ}30'$ - $114^{\circ}37'30''$ W, 1964

603. Hare, Kenneth F. CAUSATION OF THE ARID ZONE UNESCO, Arid Zone Res., No. 17 pp. 25-30, 1961 DWB

Causes of widespread aridity in subtropical latitudes in both hemispheres are investigated. Certain dynamic factors connected with general circulation of the atmosphere are involved, since the scarcity of rainfall is found over

oceans as well as over continents. In the atmospheric circulation in the lower troposphere it is demonstrated by examples that the humidity in the lower layers of the atmosphere does not produce sufficient rainfall, nor does the proximity of large bodies of water. Recent research into vapor transport has emphasized that the true sources of precipitable water are very different from the ideas formerly held. The role of the tropics in the general atmospheric circulation is discussed. Along with breaks in geographical continuity of the arid zone, it is concluded that aridity in the subtropics is dependent upon the Earth's general atmospheric circulation, which cannot be significantly changed by human intervention, and that past climatic epochs could have experienced a complete absence of subtropical aridity.

604. Harshbarger, J.W. and others ARIZONA WATER US Geol. Survey Water-supply paper 1648, 85 pp., incl. illus., 1966

This report discusses Arizona's problems of high evaporation scarcity of surface water, declining ground water levels, and soil salinity. It considers possible methods of water conservation, and suggests ways of better water management to avoid future shortage. Nontechnical, this report is aimed at the general public as well as the professional. This paper was revised by H.L. Baldwin.

605. Hastings, James Rodney CLIMATOLOGICAL DATA FROM SONORA AND NORTHWESTERN SINALOA Ariz. Univ. Inst. Atmos. Phys., Tech. repts. on meteorol. and climatol. of arid regions, No. 15, 152 pp., incl. tables, October 1, 1964
DLC QC993.7.T4

Second part of this series to deal with the basic climatology of the Mexican part of the desert, it presents monthly precipitation and temperature records for 111 stations in Sonora and Northwestern Sinaloa. The Sonoran Data through 1958 appear in Boletín Hidrológico No. 13 of the Secretaría de Recursos Hidráulicos, The Mexican publications are difficult to acquire in the US because they contain minor computational errors. However, because 4 years of additional observations are now available, their republication and re-editing appear to be desirable. With Reports 14 and 15 and data from the US Weather Bureau, it will be possible to construct, for the first time, a climatological model of the Sonoran Desert. Only station having at least a five-year precipitation have been included.

606. Hastings, J.R. and R.M. Turner SEASONAL PRECIPITATION REGIMES
IN BAJA CALIFORNIA, MEXICO Geograf. ann., A, v.47, no.4
pp. 204-23, 1965, 36 ref. DLC G25.64

This region now contains 125 functioning meteorological stations and is divided into six vegetationally and climatically distinct provinces, and mean, areally weighted precipitation totals computed for them. Precipitation varies from 30 mm in the North to 747 mm in the South -- sustained aridity being the rule. Seasonal differences in precipitation are examined in detail and coefficients of variation given for 19 stations. Also computed for these stations is the spatial variability of precipitation and a Spearman-rank difference correlations. Winter has the least spatial variability, followed by spring. Fall precipitation is intermediate between the values for summer and spring. In general, the regimes are highly seasonal and relative seasonal differences in the amount and reliability of the precipitation appear to be the chief factors in differentiating the six vegetation zones.

607. Healy, John R. INVENTORY OF RESEARCH ON DESERT REGIONAL TYPES
Chapt. 9 of, An Inventory of Geographical Research on Desert Environments, ed. by Wm. G. McGinnies, B.J. Goldman, and Patricia Paylore. Ariz. Univ. Office of Arid Lands Studies, 1969, 69 pp. AD 686 836

Purpose is to determine in detail what topics have been, or are being investigated for the world's deserts, to appraise the reported work, and to disclose areas of study where further work is needed. The series of chapters does not attempt to recapitulate all information known about the deserts of the world, but rather comprises a compendium-guidebook to past and present research. It is based upon a critical review of the published literature augmented by consultations with specialists.

608. Heindl, L.A. GROUND WATER IN FRACTURED VOLCANIC ROCKS IN SOUTHERN ARIZONA In: Hydrology of fractured rocks -- Dubrovnik Symposium, 1965, Proc., v.2: Internatl. Assoc. Scient. Hydrol. Pub. 74 pp. 503-13, 1967 DLC GB651.J63 No. 74

The water-bearing potential of fractured volcanic rocks in southern Arizona is virtually untested, largely because adequate amounts are obtained from alluvial deposits. Wells in the flows yield up to 1,000 gpm, but these are variable and cannot now be predicted. Fractured volcanics in the

basin-and-range area also underlie areas of recharge in the mountains and act as conduits to transmit water to ground water reservoirs in alluvium of basin fill or in permeable volcanic rocks buried by or interbedded with alluvium. Criteria are needed to identify, map, and project fractures to below the surface. Principal means for meeting these needs are determination of relationship of permeability to mode and environment of extrusion and deposition, and to subsequent deformation and erosion.

609. Heindl, L.A. MESOZOIC FORMATIONS IN THE VEKOL MOUNTAINS, PAPAGO INDIAN RESERVATIONS, ARIZONA US Geol. Survey, Bull. 1194-G, 9 pp., 12 ref., 1965 DLC QE79.B9

Mesozoic deposits in the Vekol Mountains include the following: the Phonodoree Formation consisting mostly of quartzitic rocks; the Vekol Formation consisting largely of gray-green arkoses, graywackes and pebble conglomerates, and a local basal angular conglomerate member composed mainly of volcanic material; and the Chiapuk Rhyolite, a welded ash flow. The formations are of probable late Mesozoic, possibly Cretaceous, age.

610. Heindl, L.A. GROUND WATER SHADOWS AND BURIED TOPOGRAPHY, SAN XAVIER INDIAN RESERVATION, PIMA COUNTY, ARIZONA US Geol. Survey, Prof. paper 450-C, pp. 120-22, 1962, 5 ref. DLC QE75.P9

Ground water shadows, areas of low yield bounded by areas of higher yield or by nearly impermeable rocks, reflect influence of depositional environments on local ground water conditions. Ground water shadows along the Santa Cruz River correlate with surface and buried topography, and are helpful in outlining areas of high yield.

611. Heindl, L.A. MESOZOIC FORMATIONS IN THE COMOBABI AND ROSKRUGE MOUNTAINS, PAPAGO INDIAN RESERVATION, ARIZONA US Geol. Survey, Bull. 1194-H, pp. H1-H15, incl. illus., 1965 DLC QE75.B9

A composite Mesozoic section in the Comobabi and Roskrige Mountains of southcentral Arizona is defined and described. The section comprises six new formations which consist of andesitic to rhyolitic volcanic rocks and of sedimentary deposits largely derived from them. A composite section

is between 20,000 and 35,000 feet thick. Dinosaur fragments in the Cocoraque Formation are of late Mesozoic age, and the upper part of the Roskrige Formation is Late Cretaceous. The lowest unit is considered to be Mesozoic because it is so unlike Precambrian or Paleozoic strata in this region. More precise dating of all formations is necessary before restriction of the section to Cretaceous can be assumed.

612. Heindl, L.A. CENOZOIC GEOLOGY OF THE PAPAGO INDIAN RESERVATION, PIMA, MARICOPA AND PINAL COUNTIES, ARIZONA: A PRELIMINARY SUMMARY Ariz. geol. soc., digest, v.3, pp. 31-34, 3 ref., 1960 DLC unbound

The Papago Indian Reservation includes about 4,300 sq. mi. in central Pima County. Cenozoic rocks comprise a diverse series of sedimentary, intrusive, and volcanic sequences. They generally rest with angular unconformity on Precambrian, Paleozoic, or Mesozoic intrusive or sedimentary rocks. Locally, the oldest Cenozoic rocks may represent a continuation of late Mesozoic deposition. Elsewhere, the younger Cenozoic rocks lie on intrusive or metamorphic rocks of possible late Mesozoic or early Cenozoic age. In many areas, the base of the Cenozoic rocks is not exposed. The Cenozoic and associated rocks are divided into 4 arbitrary age groups -- Quaternary and Tertiary, late (?) Tertiary, middle (?) Tertiary, and Cretaceous and Tertiary. They are further subdivided into 14 sedimentary or volcanic sequences and 3 episodes of intrusion. Although only 3 intrusive episodes are described, small intrusive bodies are associated with all periods of extrusion.

613. Heindl, L.A. and John F. Lance TOPOGRAPHIC, PHYSIOGRAPHIC AND STRUCTURAL SUBDIVISIONS OF ARIZONA Ariz. geol. soc., digest, v.3 pp. 12-18, incl. maps, 15 ref., March 1960 DLC unbound

Briefly reviews the existing schemes of topographic, physiographic and structural boundaries in Arizona and proposes the use of a boundary based on structural differences, as they are now understood, to separate the Colorado Plateau and Basin and Range provinces.

614. Heindl, L.A. and Neal F. McClymonds YOUNGER PRECAMBRIAN FORMATIONS AND THE BOLSA (?) QUARTZITE OF THE CAMBRIAN AGE, PAPAGO INDIAN RESERVATION, ARIZONA US Geol. Survey, Prof. paper 501-C, pp. 43-49, incl. illus., table, 16 ref., 1964
DLC QE79.P9

The Apache Group of younger Precambrian age crops out in 1500-foot sequences in the Vekol and Slate Mountains. An overlying clastic unit, heretofore referred to the Troy Quartzite, is correlated tentatively with the recently re-defined Bolsa Quartzite of Cambrian age. This clastic unit is here designated the Bolsa (?) Quartzite. It is also exposed in the Waterman Mountains where, however, it rests on granitic rocks. It is overlain conformably by the Abrigo Formation of Cambrian age in the 3 mountain ranges.

615. Heindl, L.A. and others SUMMARY OF OCCURRENCE OF GROUND WATER ON THE PAPAGO INDIAN RESERVATION, ARIZONA US Geol. Survey, Hydrol. inv. Atlas HA-55, scale 1:250,000, 1962

Describes the general geology and ground water hydrology of the Papago Indian Reservation in the Basin and Range province of southern Arizona. The reservation is divided into 4 ground water areas. These are: (1) the essentially nonwater-bearing areas of predominantly crystalline rocks; (2) locally water-bearing limestone areas; (3) the locally water-bearing volcanic areas; and (4) the generally water-bearing deep alluvial basins.

616. Helgeson, Harold C. GEOLOGIC AND THERMODYNAMIC CHARACTERISTICS OF THE SALTON SEA GEOTHERMAL SYSTEM Amer. jour. sci., v.266, no.3 pp. 129-66, incl. illus., table, 1968
DLC Q1.A5

The area is in the San Andreas Rift Valley of southern California. The geothermal reservoir is in an arkosic sandstone more than 2000 ft thick and below an insulating shale 2 to 3000 ft deep. Interstitial concentrated NaCl - CaCl₂ - KCl brine occurs; no stream is present. At 3000 ft, the temperature exceeds 300°C and is 360°C at 7000 ft. Mineral reactions and alterations are described. Below the shale, the temperature-depth profiles approach adiabatic gradients. Thermal convection of the pore fluids is the primary mechanism of heat transfer. The temperature gradient is equated to salinity with changes in depth. Various other physical features are evaluated. The brine formed by the evaporation of Colorado River water trapped in the reservoir sands.

617. Hely, Allen G., G.H. Hughes and Burdge Ireland
HYDROLOGIC REGIMEN OF SALTON SEA, CALIFORNIA US Geol.
Survey, Prof. paper No. 486-C, 32 pp., ref., 1966
DLC QE79.P9

A study of the variations in water level and water quality and their causes in Salton Sea, California. Results are given on studies of water level, inflow, evaporation, chemical quality, and their interrelations, based on an intensive investigation conducted during 1961- 1962 and on available records for previous years. Information is given on the equipment and procedures used. Man's influence on the hydrologic regime of Salton Sea and various schemes for regulation are set forth.

618. Hills, E.S. (ed.) ARID LANDS: A GEOGRAPHICAL APPRAISAL
London, Methuen; New York, Barnes and Noble, 1967, 479 pp.,
incl. illus. DLC GB611.H5

General summary of the geography of the arid zones of the world. Full regional treatment is not given, but illustrative examples have been taken from all major areas. Articles relevant to the project are abstracted separately and include: C.C. Wallen, Arid zone meteorology; E.S. Hills and others, Geomorphology; T.N. Jewitt, Soils of arid lands; Karl Butzer and C.R. Twidale, Deserts in the past; M. Kassas, Plant life in deserts; and E.B. Edney, Animals of the desert.

619. Hills, E.S., C.D. Ollier and C.R. Twidale GEOMORPHOLOGY
In: E.S. Hills (ed.) Arid lands: a geographical appraisal
London, Methuen, 1966, pp. 53-76, incl. illus., 15 ref.
DLC GB611.H5

It is the physiographic processes resulting directly and indirectly from the arid climate that give arid lands their unity -- these processes act on rocks and structures that are no different from those in other parts of the world. Examples of the varying geological environments are given. Weathering processes and the weathering front are described. Water and wind processes and the resulting landforms are described. A final section discusses the characteristics of desert sand. The sand sometimes comes from extensive alluvial or marine deposits, but it can also be derived from local outcrops by weathering and deflation.

620. Hill, Robert T. PECULIAR FORMATIONS OF THE MEXICAN ARID PLATEAU
Engineering and mining journal, v.83 pp. 663-66, incl.
illus., 1907 DLC TAl.E56

Discusses the peculiarities of limestone weathering in arid climates, the occurrence of Yeso, an eolian continental type of sediment, along with incrustations such as caliche and tepetate, the occurrence of turrent or tail dunes, which he calls "Mesquite Mounds," and the occurrence of altered volcanic rock used for building stone, Jaboncilla and Cantera. Also reported are a ryholitic ogglomento bed 500' thick along the aros and Tutriaca Rivers of Chihuahua, and the San Domingo River of Sonora which weathers to pennacled cliffs and rounded dunes. No maps but three photos are included.

621. Hinds, Norman E.A. EVOLUTION OF THE CALIFORNIA LANDSCAPE
Calif., Div. Mines, bull. 158, 240 pp., incl. illus., maps,
ref., 1952, reprinted 1960 DLC QE89.H53

This volume attempts to bring together information about the various parts of the state for the layman to learn more about places he has seen or may see. Abundant pictures, sketches, and diagrams are included. This discussion of the landscape of California is concerned principally with events which took place during the Cenozoic era, but some dating as far back as the Jurassic and Cretaceous are also of great significance. In landscape evolution, the first imprints recognizable in California today were made in Jurassic time, when the ancestors of the Klamath Mountains, the Sierra Nevada, part of the Transverse Ranges, the Peninsular Ranges, and some other ranges appeared. Chapters are: Sierra Nevada, Basin-Ranges, Mojave Desert, Colorado Desert, Modoc Plateau, Cascade Range, Klamath Mountains, Great Valley, Coast Ranges, Transverse Ranges, Peninsular Ranges, and Sea Floor.

622. Hodge, Carle and Peter C. Duisberg (eds.) ARIDITY AND MAN:
THE CHALLENGE OF THE ARID LANDS IN THE UNITED STATES
Washington, American Asso. for the Advancement of Sci.,
Pub. No. 74, 1963. 584 pp., incl. illus., maps, ref.
DLC GB614.A5

This book was a contribution of the Committee on Desert and Arid Zone Research (CODAZR) to the conference devoted

to research on Latin American arid lands, held in Buenos Aires in September 1963. A product of 74 scientific contributors, it is designed for use by researchers as well as scientific administrators and government leaders. The chapters are devoted to a review of the development and use of arid lands in the US, emphasizing both successes and failures. The 1st part covers the historic, meteorologic, geologic and ecologic aspects of the arid regions, and the economic, social and political factors influencing their origin, development and use. The latter part deals with case histories of aridity problems.

623. Hoff, C. C. ayton and Marvin L. Reidesel (eds.) PHYSIOLOGICAL SYSTEMS IN SEMIARID ENVIRONMENTS Albuquerque, Univ. of New Mexico Press, 1969, 239 pp. \$9.00

Seminar papers and abstracts on topics ranging from challenges and opportunities for desert animal physiologists to a discussion of gradients in species composition of desert vegetation.

624. Hooke, R. LeB PROCESSES ON ARID-REGION ALLUVIAL FANS Jour. geol., v.75, no.4 pp. 438-60, July 1967. DLC QE1.J8

Alluvial fans were studied in the field, largely in desert regions in California, and in the laboratory. Field studies consisted of detailed mapping of parts of four fans and reconnaissance work on over 100 additional fans. Features mapped include nature and age of deposits, malinal size, and channel pattern. In the laboratory, small alluvial fans were built of mud and sand transported through a channel into a 5 X 5 box under controlled conditions. Reconnaissance work included quantitative observations of features such as debris size and lithology, and channel form. Measurements of fan area and slope were made in several instances.

625. Hooke, Roger LeB STEADY-STATE RELATIONSHIPS ON ARID-REGION ALLUVIAL FANS IN CLOSED BASINS Amer. jour. sci., v.266, no.8 pp. 609-29, incl. illus., graphs, Oct. 1968, 24 ref. DLC Q1.A5

The empirical relationship between fan area, A_f , and drainage-basin area, A_d , $A_f = CA_d^n$, has been recognized previously (Bull,

1964; Denny, 1965). The present study suggests that this relationship results from a tendency toward a steady state among coalescing fans in the same lithologic, tectonic, and geographic environment. The steady state exists when all fans are increasing in thickness at approximately the same rate. If rate differs, the area of the fans change to approach a steady state. The exponent n is generally less than unity, apparently reflecting storage of debris in alluvial channels and on valley-side slopes in larger watersheds. The coefficient c may vary within a bolson due to lithologic or tectonic influences. It also varies among bolsons owing to differences in the ratio of erosional area in mountains surrounding the fans to depositional area occupied by fans. Laboratory and field observations suggest that the steady-state slope of an alluvial fan is determined by debris size, depositional process, and water discharge. Large fans have larger drainage basins and hence larger discharges than small fans. Consequently fan slope generally decreases with increasing fan area. Under otherwise equivalent conditions, fans composed of coarse material are steeper than those composed of fine material, and fans built largely by debris flows or sieve deposition are steeper than fans on which fluviate processes dominated.

626. Hooke, Roger LeB, Houn-Yi Yang, and Paul W. Weiblen
 DESERT VARNISH -- AN ELECTRON PROBE STUDY Jour. geol.,
 v.77, no.3 pp. 275-88, incl. illus., tables, 1969
 DLC QE1.J8

Cross sections of coatings of surface rocks from Death Valley and Deep Springs Valley, Calif., were polished and probed for Si, Al, Ti, Fe, Mn, Mg, Ca, and K. The coatings, which are less than 100 microns thick, usually are composed of two optically indistinguishable layers: the outer rich in FeO and MnO, and the thinner inner layer rich in SiO₂ and some constituents also contained in the rock proper, such as Al₂O₃ and K₂O. Passing outward through the coating a decrease is noted in the ratio FeO: MnO, suggesting that Fe is less soluble than Mn in the solutions contributing to the formation of the varnish.

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 27. Hornaday, W.T. CAMP-FIRES ON DESERT AND LAVA New York,
 Charles Scribner's Sons, 1919, 366 pp. DLC

A detailed narrative of a trip in 1907 from Tucson, Arizona to Sonoyta and down into the Pinate region of northern Sonora. It is primarily concerned with the botony, zoology,

and description of the terrain. Portions of the latter, especially of the Pincate craters, flows, and neighboring dunes are good. It includes two maps, one showing the route of travel and the other (p. 110) shows the location of the sand dunes west of the Pincate area, the Pincate Lava Fields, and the low sandy plain and soda deposits to the north of Adair Bay in the Gulf of California. Also included are good descriptions of the Sonoyta Oasis, Papage Tanks and lave fields, MacDougal Pass, and the Cubabi Mountains. It includes many descriptions of the plant life of the region but not as detailed or technical as that presented by others.

628. Howard, Richard A. SUN, SAND AND SURVIVAL. AN ANALYSIS OF DESERT SURVIVAL EXPERENCES IN DESERT AREAS US Air Force. Arctic, Desert & Tropic Information Center, Maxwell Air Force Base, Alabama, ADTIC pub. D-102, Jan. 1953, 42 pp. DDC AD 30 335
629. Howe, George M., Lawrence J. Reed, and John T. Ball CLASSIFICATION OF WORLD DESERT AREAS Travelers Research Center, Inc. Hartford, Conn., Contract DA-19-126-AMC-1086(N), Dec. 1968. 104 pp., incl. maps, graphs, 192 ref. (US Army Natic Labs. Earth Sciences Laboratory, Tech. rept. 69-38-ES.) AD 683 603

This report identifies and maps limits of arid and semiarid regions of the world through application of aridity criteria quantitatively expressed in terms having military significance. Because the dry world includes a wide range of thermal characteristics, from extremely hot deserts of North Africa to extremely cold semiarid Asia, sub-divisions were based on features of monthly temperature. The world-wide distribution of arid and semiarid conditions is presented on one map. Details of both aridity and thermal classification are shown on eight continental and sub-continental maps for Euraisa, Southwestern Asia, North Africa, South Africa, Australia, South and Central America, Europe, and North America. Aspects of climate and terrain that are of significance to Army operations are described.

630. Humphrey, Robert R. A DETAILED STUDY OF DESERT RAINFALL
Ecology, v.14, no.1 pp. 31-43, Jan. 1933 DLC QH540.E3

A brief report on a study conducted at the Desert Laboratory of the Carnegie Institution of Washington, in Tucson, to investigate differences in rainfall on a small area in a desert climate and to determine their possible effects on vegetation.

631. Hunt, Charles B. GEOLOGIC HISTORY OF THE COLORADO RIVER
In: Colorado River region and John Wesley Powell. US
Geol. Survey Prof. Paper 669-C, pp. 59-130, incl. illus.,
tables, 1969 DLC QE75.P9

The geologic history of each stretch of the Colorado River and its principal tributaries from their headwaters to the Gulf of California is reviewed. Neither antecedence nor superposition alone seems adequate to account for the anomalous canyons across the many structural barriers, but a combination of the processes (anteposition) resolves most seeming conflicts in the evidence. This concept of duality assumes a river course superimposed across a barrier and its canyon subsequently deepened by antecedence because of latter uplift of the barrier. Stratigraphic evidence at several uplifts indicates this history; the Grand Canyon was eroded before middle Miocene time. The ancestral drainage probably discharged westward at Peach Springs; it had reached the delta before the end of Miocene time.

632. Hunt, Charles B. STRATIGRAPHY OF DESERT VARNISH US Geol.
Surv., Prof. paper 424-B, pp. 194-95, 1961, 4 ref.
DLC QE75.P9

Archeological evidence indicates that in the western United States the extensive surfaces stained with desert varnish (iron and manganese oxide) became stained sometime prior to about 1 A.D. Archeological evidence indicates that the last major period of deposition of desert varnish was during the pluvial period that immediately preceded the Christian era.

633. Ives, Ronald L. THE PINACATE REGION, SONORA, MEXICO Calif.
Acad. Sci., Occasional papers, no. 47, 43 pp., incl. illus.,
1964, 46 ref. DLC Q11.C18 #47

Field evidence in the Pinacate Region discloses a complex sequence of physiographic and climatic changes using a relatively short time. Datings can be only tentative. Most materials at Pinacate are too old for effective radio-carbon dating; and too young for effective use of He-Pb²⁰⁶, or similar methods. Largely by extrapolation from other areas, it is concluded that the first major lave outpouring at Pinacate occurred at about the time of the Pliocene-Pleistocene transition, or perhaps 1 m.y. ago. From the sequence at Punta Penasco the first major lave outpouring was followed by a period of erosion, then by eruptions of ash, and later by another massive outpouring of basalt. These lavas were extensively faulted and eroded, so that only the exposures at Punta Penasco and Batamote remain today. A second stratigraphic sequence, partly overlapping the first, is furnished by the sediments and shorelines at Pelican Point, just W of Bahia la Cholla. Study of more complicated geological sequences suggests that the main Pinacate Peaks attained approximately their present height and shape perhaps 100,000 yr ago; and the lave cascade, many of the peripheral lavas, and most of the cinder cones date from the Wisconsin, during which most of the great calderas were formed. The most recent lavas, and some of the smaller spatter cones (as at Batamote), are probably of very late Wisconsin age. Most recent major activity at Pinacate was almost the last ash eruption at Cerro Colorado, concerning which there is apparently a Papago legend, suggesting that it took place after 700 A.D. The presence of volcanic ash in a sedimentary stratum also containing Hohokam artifacts (about 700-1300 A.D.), at Sonoyta, lends support to this speculation.

634. Institute of Biology, London, Eng. BIOLOGY OF DESERTS. PROCEEDINGS OF A SYMPOSIUM ON THE BIOLOGY OF HOT AND COLD DESERTS ORGANIZED BY THE INSTITUTE OF BIOLOGY Edited by J.L. Cloudsley-Thompson. New York, Stechart-Hafner, Inc., 1954, 224 pp. DLC GB611.I5 1954

Contains papers read at a Conference on The Biology and Productivity of Hot and Cold Deserts, organized by the Institute of Biology and held at the Royal Institution during September 25th, 26th, and 27th, 1952. The symposium consisted of 6 sessions devoted to various aspects of desert biology: (1) Climate and Physical Environment, (2) Plant Ecology, (3) Entomology and Ecology, (4) Economic Aspects,

(5) Mammalian Physiology and Ecology I and Mammalian Physiology and Ecology II. Several articles of relevance to the project by N. Wright, Frank Debenham, R.A. Bagnold, K. Schmidt-Nielsen, and J.S. Weiner will be abstracted separately.

635. International Biometeorological Congress INDOOR CLIMATE IN ARID AND HUMID ZONES Symposium during the Third International Biometeorological Congress, Pau, France, Sept. 1-7, 1963. Internatl. jour. biometeorol., v.8, no.2 pp. 99-150, Dec. 1964 DLC QH543.I5

Papers presented at the Symposium are given. Articles of potential relevance to the project include: Bianca, W., Animal housing in hot countries, pp. 99-101; Peleg, M. and N. Robinson, Thermal behavior of walls and ceiling models and of various types of housing, pp. 125-36; Raychaudhuri, B.C., and others, Thermal characteristics of unconditioned insulated masonry buildings in hot arid regions. pp. 137-45.

636. Ives, R.L. HIGH SEA LEVELS OF THE SONORAN SHORE Amer. jour. sci., v.249, 1951 pp. 215-23 DLC Q1.A5

Elevated shorelines, tombolo bars, shell banks, and widely distributed marine shell high above the present shoreline along the Sonora shore of the Gulf of California indicate the former existence of two or more high sea levels. Present evidence suggests that the older high shoreline was approximately 115 feet above that at present; and a younger level at about 75 feet above the present. Includes a map of Sonora shore and adjacent areas, especially good of Pincate lave fields and portions of the sand dunes of the Gran Desierto.

637. Ives, R.L. AGE OF CERRO COLORADO CRATER, PINCATE, SONORA, MEXICO Amer. geophys. union, trans., v.37, no.2 February 1956, pp. 221-23 DLC QE500.A6

Cerro Colorado Crater, a prominent landmark at Pincate, Sonora Mexico, has a minimum age of about 150 years as determined from physiographic evidence; a geologic age not greater than that of the most recent ash falls at Pincate, and an archaeological age probably not exceeding 1000 years. Includes map of the Sonoyta River area showing dunes, lave flows, mountains intermittent and permanent streams. Map covers from 30-45N to 32-15N latitude and 112 to 11410W longitude. Small bibliography included.

638. Ives, Ronald L. "PESTIFEROUS WINDS" OF THE UPPER GULF OF CALIFORNIA Weatherwise, v.15, no.5 pp. 196-99, Oct. 1962
DLC

Although the norte would probably be classed as a "local wind" in a compendium such as Humphreys' Physics of the Air, it afflicts an area exceeding 50,000 mi several times each winter, and is economically important to the Mexican fishing and tourist industries. Physiological importance of the wind is probably considerable, as nortes commonly bring the coldest weather of the winter to these normally pleasant areas, where the inhabitants are not inured to cold, and where warm clothing and adequate house heating are not available. Since the first reference to these winds, in 1540, they have been mentioned in almost every major trip report and exploration account from the Sonoran Desert area. Sedimentation on studies in northwestern Sonora and southwestern Arizona suggest that the norte winds have blown with substantially their modern intensity since at least the later part of the Pleistocene ice age.

639. Ives, Ronald L. DISCOVERY OF PINICATE VOLCANO: THREE NARRATIVE ACCOUNTS OF AN EXPLORATION OF THE SONORAN DESERT AREA IN 1701 Science monthly, v.54, pp. 230-37, 1942, ref.
DLC Q11.P3

Relates the history of the Pinacate Volcanos and the history of their discovery and exploration. The article contains a useful map showing the sand dune area bordering the volcanos as well as the location and extent of the lava flows and related volcanic cones.

640. Ives, Ronald L. SHELL DUNES OF THE SONORAN SHORE Amer. jour. sci., v.257, no.6 pp. 449-57, incl. illus., maps, June 1959, 16 ref. DLC Q1.A5

The Great Sand Dunes along the NE shore of the Gulf of California extend from N of Yuma, Arizona to S of Puerto Penasco, Sonora, but their composition changes abruptly just W of the Pinacate Peaks, of Sonora. To the N, the dunes are composed largely of rock fragments and are in part reworked Colorado River sediments; to the S they are composed largely of shell fragments, derived from recently elevated bottom marls, geologically, and probably archeologically, recent.

641. Ives, Ronald L. AN EARLY REPORT OF ABNORMAL REFRACTION OVER THE GULF OF CALIFORNIA Amer. meteorol. soc., bull., v.49 no.4 192 pp., April 1959, 5 ref. DLC QC851.A6

Examination of all known accounts of exploration and travel (including Jesuit diaries and mission records) beginning with MELCHIOR DIAZ (1540-41) shows that no primary, secondary or even third-order features have changed (such as mirages) during the past 250 years and probably not since 1540, in the vicinity of Puerto Penasco, Sonora, Mexico. Field observations by the author (1951) have shown remarkable mirages (looming) of ranges at sunset on Baja California, usually below the horizon. The diary of JUAN MARIA SALVATIERRA, S.J., records on Monday, March 19, 1701, that just before sunset and after sunset, Sierra San Pedro Maryr, 110 m distant, was clearly visible from a point 20 mi north of Puerto Penasco. However, some changes have occurred in the long-period climate because trees used to grow there.

642. Jackson, W.A. SOIL FEATURES IN ARID REGIONS WITH PARTICULAR REFERENCE TO AUSTRALIA Austral. Inst. Agric. Cis., journ., v.23, no.3 pp. 196-208, incl. tables, refs., 1967 DLC S17.A93

Soil features in the arid regions of the world are described -- including general soil morphology, desert crusts and hardpans, desert pavement, soil reaction, salinity, phosphorus content, and nitrogen and organic matter. It is concluded that all manner of soils are found in arid areas, and that to refer to "desert soils" as if they constituted a homogeneous group is both erroneous and misleading.

643. Jackson, R.D., and C.H.M. Van Bavel SOLAR DISTILLATION OF WATER FROM SOIL AND PLANT MATERIALS: A SIMPLE SURVIVAL TECHNIQUE Sci., v.149, no.3690 pp. 1377-99, 1965 DLC Q1.S35

Water obtained from soil and plant materials by a simple distillation technique can provide a means for survival under desert conditions. A yield of 1.5 liters per day of potable water was obtained from a single "survival still." The still makes use of plastic film lining a hole in the ground. Water collecting on the underside of the cone drops into a container.

644. Jacob, C.E. GROUNDWATER AND DRAINAGE OF YUMA VALLEY AND CONTIGUOUS AREAS Yuma County Water Users' Assoc., P.O. Box 708, Yuma, AZ, 50 pp., incl. illus., maps, charts, graphs, Oct. 1960, 62 ref., 9 appends., 2 suppl.

Deep percolation from the irrigation of the Yuma Auxiliary Project on the Yuma Mesa, starting in 1925, and more recently from the irrigation of the Mesa Division of the Gila Project, starting in 1947, have caused a strong ground-water underflow to Yuma Valley and have given rise to actual or potential artesian-pressure conditions under that valley. By 1945, the aggregate underflow had totaled 50,000 acre-ft and by 1959 about 500,000 acre-ft. The rate of underflow has risen sharply in recent years and reached 69,000 acre-ft in 1959. It is estimated that if the present input to the ground water mounds under Yuma Mesa levels off at its present value the underflow to Yuma Valley may in a few years level off at 83,000 acre-ft per year. If the irrigated acreage on the mesa is expanded to its allowable upperlimit, as much as 100,000 acre-ft per year of underflow may enter Yuma Valley from Yuma Mesa in the future. The artesian pressure has been kept under control in the past, first by 9 shallow drainage wells installed by the U.S. Bureau of Reclamation starting in 1947 and more recently by the 9 deep drainage wells which replaced them and which were constructed between 1954 and 1958. To the end of 1959 about 400,000 acre-ft of foreign drainage water had been pumped by these wells. The aggregate cost has been about \$1.6 million or about \$4 per acre-ft. It is recommended that 2 reinforced concrete pipelines be built across the valley project and be interconnected with the existing 9 and 3 additional deep drainage wells. These pipelines will provide a controlled though flexible system by means of which foreign drainage water can be moved across the valley to the Colorado River and be credited to the United States on the Mexican Treaty.

645. Jacobs, Woodrow C. FROST SURVEY OF IMPERIAL COUNTY, CALIFORNIA BY UNITED STATES DEPARTMENT OF COMMERCE, WEATHER BUREAU, IN COOPERATION WITH IMPERIAL COUNTY AGRICULTURAL DEPARTMENT (1941?) mimeo., 32 pp. DWB

A thorough detailed microclimatic study, based on 8 years of record (1932-40) for 27 stations in the Imperial Valley of southeastern California. This area is peculiarly subject of radiation frosts (288 nights in 8 years) which are greatly influenced by drainage, winds, and other local factors, though changes are not abrupt. A novel method of representing steepness of slope of valley floor for the various stations

employs arrows of varying length which give a qualitative estimate of the air flow in both direction and speed. The average, extreme and duration of low temperatures are shown on isothermal charts and individual freezes are plotted to show variability from night to night. Summarized for each of the 10 years, 1930-40 also.

646. Jaeger, Edmund D. THE CALIFORNIA DESERTS 4th ed. Palo Alto, California, Stanford, Univ. Press, 1965, 208 pp., incl. illus., photos, map, 90 ref. F867.J232 1965

This work provides a good, general discussion of the California deserts, and excellent photographs of the topography and animal and plant life. Topics treated are the geologic history, physiography, weather and climatic features, animal and plant life, travel hints and preservation of the desert. An excellent bibliography is included.

647. Jahns, Richard H. (ed.) GEOLOGY OF SOUTHERN CALIFORNIA Calif. Div. Mines, Bull. 170 2 vols., incl maps, illus., ref., Sept. 1954, reprinted 1960 DLC TN24.C2A3

Intended to provide a broad sampling of geological features and thought, as they relate to the southern California region, and its contents reflect an approach that is partly geographic and partly topical. Southern California is regarded as the region occupied by Imperial, Inyo, Kern, Los Angeles, Orange, Riverside, San Bernardino, San Diego, Santa Barbara, and Ventura counties although a few of the contributions deal with parts of adjacent counties.

648. Jelinek, Arthur J. RADIOCARBON DATING IN THE SOUTHWEST UNITED STATES In: Radiocarbon and tritium dating. Proceedings of the 6th International Conference held at Washington State Univ., Pullman, Wash., June 7-11, 1965. Roy M. Chatters (comp.) US Atomic Energy Commission, Rept. CONF-CFSTI, HC \$8.00; Mi \$3.25

Major time gaps in the C-14 record of the southwestern United States -- from 8900 to 7500 BC -- correspond to the post-Valders warming trend and the Altithermal respectively. They probably represent removal of cultural material by erosion. Distribution of the sites is described; the Cochise tradition is best known, and its phases and associated dates are discussed. More groups of dates are needed to fill in knowledge of these cultures.

649. Jennings, Charles W. (compiler) GEOLOGIC MAP OF CALIFORNIA, OLAF P. JENKINS EDITION -- SALTON SEA SHEET. San Francisco, California Div. Mines and Geology, scale 1:250,000, separate explanatory sheet, 1967

The explanatory sheet includes the index to geologic mapping used in compilation of the map; a stratigraphic nomenclature chart; photographs of crescentic dunes near the southwestern shore of the Salton Sea, and a view of Salton Sea area from Gemini 5, 100 miles high; and a map indicating topographic quadrangles within the Salton Sea sheet available from the US Geological Survey.

650. Jewitt, T.N. SOILS OF ARID LANDS In: E.S. Hills (ed.), Arid lands: a geographical appraisal London, Methuen, 1966, pp. 103-25, 19 ref. DLC GB611.H5

Although some soils of arid areas are only wet to a limited depth and for limited periods, there are quite extensive areas where seasonally or permanently the water table may be quite high. Salinity is often a problem, particularly under irrigation. Halophytes remove sodium from the soil, but not at a fast enough rate for it to represent a practical solution to the problem. Much salt is added by irrigation and also in rainfall. Leaching of soils high in carbonates is relatively safe: leaching of saline soils can lead to the formation of a very alkaline non-saline soil, the solonetz. Successful leaching requires either a deep water table or effective installed drains. Impermeable soils are the most difficult. The fertility of desert soils is not a problem, although they do need fertilizers -- 13% of the arable lands of the world are irrigated and they produce 25% of the world's food. the need to install adequate drainage on irrigated land is re-emphasised: on impermeable soils the spacing would need to be so close as to be uneconomic.

651. Jordan, Charles B. DESERT FIELD TEST -- ALL WEATHER BRAKE FLUID US Army. Aberdeen Proving Ground, MD, Coating and Chemical Lab, CCL Rept. 147, August 16, 1963, 36 pp. AD 418 590

652. Judson, Sheldon ARROYOS Scient. amer., v.187, no.6 pp. 71-76, Dec. 1952 DLC T1.S35

The Rainfall pattern in the Southwest was apparently different during the last half of the 19th century than it was

immediately before or after. This started a cycle of erosion, which was aggravated by the over-grazing of that period. Such cycles have occurred before man could have been a possible factor. Thus, such artificial influences as grazing are considered to be of a minor importance in the formation of the deep, dry gullies known as arroyos.

653. Jurwitz, Louis R. RAINFALL IN ARIZONA Ariz. highways, v. 30, no. 7 pp. 6-15, July 1954 DLC TE24.A6A87

A popular account of the atmospheric circulation, of the storm systems affecting Arizona and their relationship to the atmospheric circulation, the mechanisms involved in generating summer and winter rainfall, and the amount and distribution of rainfall. Charts show average annual precipitation, and greatest 24-hour precipitation for Dec., Jan. or Feb., and July, Aug. or Sept.

654. Jurwitz, Louis R. ARIZONA'S TWO-SEASON RAINFALL PATTERN Weatherwise, v. 6, no. 4 pp. 96-99, August 1953 DLC QC851.W42

Notes on the general climate of Arizona followed by a more detailed discussion of synoptic conditions giving rise to heavy local rains in parts of the state. The record summer season rainfalls occur as an aftermath of hurricanes moving into Mexico and dissipating but allowing deep columns of moist air to flow across Mexico into Arizona, or to tropical cyclones moving NE from Lower California. Winter rains are more general and occur when frontal systems move east from the Pacific off California -- especially from Southern California coastal region.

655. Kerr, Richard C., and John O. Nigra ANALYSIS OF EOLIAN SAND CONTROL Amer. assoc. petrol. geologists, bull., v. 36, no. 8 pp. 1541-73, Aug. 1952, incl illus., ref. TN860.A3

Oil-field operations in desert or semi-arid areas of the world are inevitably faced with the problems of sand encroachment and accumulation. Not only is this a serious hazard to equipment, but the labor of removing sand is a constant drain on manpower and transportation resources. The cost of eliminating or stabilizing sand becomes then a frequently

recurring charge against operations. Fortunately in recent years, engineering-geology studies on sand control have advanced sufficiently to prove that drifting sand can be effectively and permanently trapped and retained. Eolian sand control has four fundamental objectives; (1) the destruction or stabilization of sand accumulations, such as dunes, in order to prevent their further migration and encroachment on operational sites; (2) the diversion of wind blown sand around buildings or areas; (3) the direct and permanent stoppage or impounding of sand before the location or object to be protected; and (4) the rendition of deliberate aid to sand movement so as to avoid deposition over a locale. In order to achieve these objectives, the following methods can be employed singly or in combination: (a) transposing, (b) planting, (c) paving, (d) panelling, (e) fencing, and (f) oiling. A theoretical treatment of the sand-control objective is presented in Part 1. The practical implementation and relative evaluation of each control method are discussed in Part 2.

656. Kennedy, John F. THE FORMATION OF SEDIMENT RIPPLES IN CLOSED RECTANGULAR CONDUITS AND IN THE DESERT Jour. geophys. res., v.69, no.8 pp. 1517-24, April 15, 1964, 13 ref. DLC QC811.J6

The development of sediment ripples on an initially flat bed in a closed rectangular conduit is analyzed as a stability problem by examining the kinematics of sediment motion. Central steps in the analysis are the use of the potential flow over a moving bed having a sinusoidal form and a time-varying amplitude to predict the velocity distribution and the introduction of a sediment transport relation in which the local transport rate at any point is proportional to a power of the local velocity a distance x upstream. Analysis is extended to sediment ripples formed by wind-driven sand in arid regions by allowing the conduit depth to tend to infinity. Formulas are developed for the length, velocity of movement, and height of sediment ripples. Calculated and measured values of the ripple index are found to agree satisfactorily. The mathematical model suggests an explanation for the flat, rippleless surface that occurs at higher velocities; it also forms the basis for a hypothesis that ripples result from a systematic perturbation of the bed load movement, whereas dunes are initiated by a perturbation of the suspended sediment load.

657. Kam, William GEOLOGY AND GROUNDWATER RESOURCES OF THE McMULLEN VALLEY, MARICOPA, YAVAPAI, AND YUMA COUNTIES, ARIZONA
Ariz., State Land Dept., Water res. rept. no. 8, 72 pp.,
incl. illus., tables, 1961, 21 ref. DLC PRR Also: US
Geol. Survey, Water-supply paper 1665, 64 pp., 1964, 22 ref.
DLC QE86.M3K3

McMullen Valley in western Arizona, is about 48 mi long and 15 mi wide, and drained by Centennial Wash, an intermittent tributary of the Gila River. The annual average precipitation is 9 in. The rock units in McMullen Valley are: (1) Precambrian igneous and metamorphic rocks; (2) Paleozoic sedimentary rocks; (3) Mesozoic (?) intrusive rocks; (4) Tertiary (?) intrusive rocks; (7) Quaternary volcanic rocks; and (8) Quaternary valley-fill deposits. The valley-fill deposits are divided into 4 subunits: (1) conglomerate; (2) alluvial-fan deposits; (3) lake-bed deposits; and (4) alluvium. The most conspicuous structural features in the area are tilted horsts and grabens. The principal aquifer consists of valley-fill deposits in the trough between the mountain ranges. The buried parts of the mountain ranges, which are the boundaries of this aquifer, are barriers to subsurface movement of ground water into or out of the valley-fill deposits. The general direction of the movement of ground water in the valley-fill deposits in southwestward to Salome and then south-eastward through Harrisburg Valley. The ground water reservoir in the valley-fill deposits is recharged principally by seepage from irrigation. Prior to the development of irrigation, ground water was discharged from the valley primarily by underflow and evapotranspiration; however, pumping has been relatively heavy in Harrisburg Valley so that little or no ground water now leaves the valley as underflow, and evapotranspiration probably has been lessened.

658. Kangieser, Paul C. USE OF THE MEAN AS AN ESTIMATE OF "NORMAL" PRECIPITATION IN AN ARID AREA US Weather Bur., Western Regional Tech. Mem. No. 15, Nov. 1966, 4 pp. DAS M(055) U587wet

This manuscript was prepared from data computed for a study. The computations were made to reflect the probability that the "normal" precipitation at a given station will not be exceeded. The results are presented in a chart of probability level(%) of mean annual precipitation, showing that, for the annual series, the "normal" lies near the 50%

level over much of the state, and in probability level (5) of mean monthly precipitation for May showing that "normals" in a dry month lie above the 50% level in all parts of the state, with increasingly high probabilities in the arid southwestern section. In fact, a fig. shows that a quotation of a "normal" for May in the Yuma area will over-estimate the observed value in approximately 9 out of 10 years.

659. Kassas, M. PLANT LIFE IN DESERTS In: E.S. Hills (ed.), Arid lands: a geographical appraisal. London, Methuen, 1966, pp. 145-80, incl. illus., tables, 49 ref.
DLC GB611.H5

Desert plants exhibit special characters of morphology, physiology and synecology. The three main growth forms are ephemeral annuals, succulent, and non-succulent perennials. The morphological, anatomical and physiological characteristics of xerophytic plants are described with examples. Classification is discussed and a system explained. The ecosystem includes the problem of the impact of man. Climax communities are of value as indicators of land-use potential.

660. Kassas, M. and M. Imam CLIMATE AND MICROCLIMATE IN THE CAIRO DESERT Soc. geogr. Egypte, Bull. no. 30 pp. 25-50, 1957 (original unchecked) Abstract from Cairo. Scient. & Tech. Doc. Cent., bull., pt. 2, v. 4, no. 9: pp. 117, Sept. 1958

The application of several formulas and systems suggested for the classification of climate shows the intensive aridity of the climate of the Cairo desert. Studies on the microclimatic features show that adjacent points may differ in their temperature and moisture conditions in relation to relief. The south-facing slopes are consistently warmer than the north-facing slopes. The lower levels receive more water than the higher levels. Microclimatic differences correspond to microhabitat and vegetational differences.

661. Kasyanova, M.S. AEROVISUAL GEOBOTANICAL OBSERVATIONS IN DESERTS AND SEMIARID REGIONS Translated by Gaida M. Hughes Internatl. geol. rev., v. 3, no. 7 pp. 626-28, July 1961 DLC QE1.I7

The techniques of aerogeologic observations and the coordination of such observations with ground studies are

described. Some broad distinctions of plant associations are described, notably those including various aspects of sagebrush (Artemisia), beachgrass (Calamagrotis), Tamarix and various desert grasses. Certain species are best mapped when seasonal color changes occur. The violet bloom of the halophyte Statice suffruticosa, for instance, makes it possible to distinguish saline areas on the Ustyurt plateau. Aerovisual observation gives the supervisor a chance to check the mapping accuracy of subordinates.

662. Kellum, L.B. GEOLOGIC HISTORY OF NORTHERN MEXICO AND ITS BEARING ON PETROLEUM EXPLORATION Amer. assoc. petrol. geologists, bull., v.28 pp. 301-25, 1944 DLC TN860.A3

Buried platforms comparable with the Coahuila Peninsula of north-central Mexico are known to be present in several of the major downwarped areas in the central and coastal United States and beneath the coastal plain of eastern Mexico. It is believed that others may be present. The purpose of this paper is to point out certain criteria which may aid in their discovery. A series of paleogeographic maps has been compiled to show the geologic development of Mexico during late Paleozoic and Mesozoic time. The stratigraphic section on the buried Coahuila Peninsula is in marked contrast to the deposits in the geosyncline on the south. This is due to the influence of the underlying massif on sedimentation throughout a long period of geologic time. It indicates that facies of deposition may be used as a guide in locating buried positive elements in the subsurface.

663. Kelly, C.F., T.E. Bond and N.R. Ittner
SKY TEMPERATURES IN THE IMPERIAL VALLEY OF CALIFORNIA
Amer. geophys. union, trans., v.38, no.3 pp. 308-13,
June 1957, 18 ref. DLC QE500.A6

The cloudless sky in the Imperial Valley is shown to have possibilities as a heat sink for cooling livestock and structures. Measurements with a directional radiometer and other instruments indicated that a point in the north sky 60° above the horizon is usually as cool as, or cooler than, other parts of the sky. North sky temperatures averaged 20° to 30° lower than air temperatures near the ground. The correlation of observed sky temperatures with sky temperatures calculated by Brunt's empirical equation from ground observations was 0.58, highly significant.

664. Kerr, Paul F. and Arthur M. Langer MINERALOGICAL FEATURES
OF MOHAVE DESERT PLAYA CRUSTS In: US Air Force, Cambridge
Res. Labs., Geology, mineralogy and hydrology of US playas
Its Environmental res. paper 96 (AFCRL065-266), pp. 31-72,
incl. illus., tables, 1965 DLC TRC: Ad 616 243

Six surface types of playa crusts are found in the Mojave Desert, California. The constituents are essentially clay minerals and other sheet silicates, granular minerals (oxides and silicates), and saline components. Physical properties of crusts depend largely on relative proportions of mineral constituents and presence or absence of moisture. Hard, dry, compact, impermeable crusts have Knoop indentations values suggesting high bearing strength and contain over 50 percent clay minerals, high carbonate content, and low soluble saline content. Puffy surfaces have less than 35% clay and a low carbonate and high saline content, as well as considerable granular material, moderate permeability, and are strongly affected by rains. An intermediate type has 35% to 49% clay and transitional properties but resemble clay-surface playas. Other types are salt pavement, calcareous, and permanently wet crusts.

665. Kesseli, John E. and Chester B. Beaty DESERT FLOOD CONDITIONS
IN THE WHITE MOUNTAINS OF CALIFORNIA AND NEVADA Calif.
Univ., (Berkeley), Rept. on Contract DA 19-129-qm 565,
Tech. rept. EP-108, April 1959, 114 pp., 24 ref. PB 142 044
Order from LC mi \$6.00; ph \$18.30

Three physiographic features were found to influence flooding behavior in a desert stream system: (1) profile of the trunk canyon; (2) amount of debris on the floor of the canyon; and (3) width of the lower canyon and canyon mouth. It is concluded that the most dangerous canyons are essentially steep, narrow, bedrock flumes with 5 to 15 feet of unconsolidated debris on their floors. In contrast, the safest drainages have gentle gradients in their trunk canyons, are deeply alluviated over their entire length, and are characterized by wide lower canyons. The area of greatest flooding danger on an alluvial fan was found to be that flanking and including the active channel. The upper and lower thirds of a fan are classified as moderately dangerous, while the middle third is subject only to slight flood damage.

666. Khudairi, A.K. MYCORRHIZA IN DESERT SOILS Bioscience, v.19,
no.7 pp. 598-600, July 1969, 8 ref. DLC QH1.A277

Mycorrhiza from the Mesopotamian Desert near Bagdad were found associated with the roots of cultivated and native trees and shrubs such as Phoenix dactylifera L. and Zizyphus spina-christi Willd. It appears that mycorrhiza of desert plants not only supply the plants with nutrients but also supply moisture during the dry season, at times taking the place of root hairs.

667. King, R.E. GEOLOGICAL RECONNAISSANCE OF CENTRAL SONORA
Amer. jour. sci., 5th ser., v.28, no.164 pp. 81-101, incl.
illus., maps, 1934 DLC Q1.A5

This report is a preliminary report upon the occurrence of Paleozoic sediments in central Sonora. A good index map shows the area studied and a reconnaissance geologic map is included. The sedimentary and volcanic rocks range from Ordovician to Quaternary. Two pages are devoted to Geomorphology of the region, which contains three large drainage basins. West of the 110° meridian, the author states the area contains inselbirge-pediment topography. the author also notes the lack of alluvial fans within the region.

668. Klots, A.B., and E.B. THE COMMUNITY OF LIVING THINGS IN THE
DESERT Mankato, Minn., Creative Educational Society, Inc.
1967, 126 pp., incl map

This introduction to the biology of the deserts intended for the general reader and science students on the high-school level presents background information on the origins of deserts, the conditions of life that prevail there and the whole interrelated activity of the plants and animals of these lands.

669. Krutch, Joseph Wood THE VOICE OF THE DESERT. A NATURALIST'S
INTERPRETATION New York, William Sloane Associates, Inc.,
1955, 223 pp., incl. illus. DLC QH88.K7

A description based on scientific fact and intimate personal experience of plant and animal life in the desert of the Southwest. The author discusses various practical and philosophical aspects of desert ecology, evolution, animal behavior, wild life management and general conservation. He

especially points out that in conservation a mere attitude of "enlightened selfishness" does not yield ultimate results. True conservation must be based on love of nature and life. It can not succeed without due regard for moral and aesthetic values, and it must be guided by more than mere economic interest in the protection and exploitation of natural resources.

670. Kuenen, Philip H. SAND Scient. amer., v.202, no.4 pp. 94-106, incl. illus., April 1960 DLC T1.S35

Geologists define sand as particles of rock between .05 and 2.0 mm in diameter. The shape of sand grains, transported by water and wind, is a clue to their history. Chemical disintegration is as important in the origin of sand as mechanical disintegration. Water is a prime agent of transportation of sand but is not so important a factor in rounding of grains as is wind. Turbidity currents explain the presence of many sand deposits on the ocean floor. Much of the present sand has undergone several cycles of erosion and deposition.

671. Kuznetsov, V.V. MAPPING SOILS OF A DESERT ZONE IN THE EXAMPLE OF WESTERN KAZAKHSTAN In: US Library of Congress, Aerospace Tech. Div., Aerial photography used in mapping vegetation and soils, May 27, 1965, pp. 94-106, incl. ref. N65-29930

A study on the use of aerial surveying materials for mapping the soil of desert landscapes is reported. Described are field and laboratory techniques used to compile soil maps in western Kazakhstan. On the basis of aerial surveying materials (uncontrolled photo-mosaics, black and white contact prints, and reproductions of rough mosaic mountains), it was demonstrated that the combined use of aerial photographic data and data from field research increased the quality of map content and allowed the classification of soils according to mechanical composition, humus content, moisture content, and salinity.

672. Lakin, Hubert W. and others VARIATION IN Mn-ELEMENT CONTENT
OF DESERT VARNISH US Geol. Survey, Prof. paper 475-B,
pp. 28-31, incl. table, 1963, ref. DLC QE75.P9

The Co content of desert varnish from Death Valley and north-eastern Nevada shows a close correlation with the Mn content of the desert varnish, and Ba, La, Mo, Ni, Pb, and Y show a general correlation. Thus the content of these elements in desert varnish may not be meaningful as an indicator of mineralized zones. Correlation with ore provinces may be represented by the high B content of varnish from Death Valley, California, by the high As and Sb content of that from the Edna Mountains, Nevada, and by the high Cu content of that from the Antler Peak-Copper Basin area, Nevada.

673. Lamberth, R.L. ON THE MEASUREMENT OF DUST DEVIL PARAMETERS
US Army. Electronics Command, Ft. Monmouth, N.J., Tech.
rept. ECOM-5019, 1965, 12 pp.

Instruments and techniques in a study of dust devils made with stationary sensors in the desert of southern New Mexico are described. Results of observation of 21 storms including measurements of pressure, wind velocity, wind direction and other parameters are presented in tabular form.

674. Langer, Arthur M. and Paul F. Kerr MOJAVE PLAYA CRUSTS --
PHYSICAL PROPERTIES AND MINERAL CONTENT Jour. sedimentol. petrol., v.36, no.2 pp. 377-96, incl. illus., 1966
DLC QE420.J69

Playa surfaces are classified in compact floors, puffy floors, salt pavements, carbonate surfaces, wet surfaces, and mixed types. The compact floors generally contain more than 50 percent clay and the puffy floors less than 35 percent clay. Size analyses, specific gravity and bulk density data, soluble salts, moisture content, are presented for 20 samples from 20 playas.

675. Larson, Peggy DESERTS OF AMERICA Englewood Cliffs, New Jersey, Prentice-Hall, 1970, 320 pp., \$8.95

The North American deserts support some of the world's most bizarre and fascinating life forms. Kangaroo rats live on dry seeds and never drink water. Toads and fresh water shrimp live in the arid sections, waiting for a two-week rainy season to provide the water they need to complete their life cycles. The Giant Saguaro cactus is often a vegetable apartment house for doves, mice, snakes, owls, woodpeckers, and even a species of desert mosquito. The packrat lives in a nest lined with cactus spines (no one knows how!) that would skewer any other animal. Larson illuminates the drastic adaptations that both plants and animals have undergone to survive their desert environment.

676. Le Sueur, H. ECOLOGY OF VEGETATION OF CHIHUAHUA, MEXICO, NORTH OR PARALLEL 28 Texas Univ. (Austin, Texas) Bull. 4521, 1945, 92 pp., DLC

Le Sueur has compiled the varied vegetation types of northern Chihuahua and these are placed into 8 or 10 groups on about the same basis as the work done by Brand and others. The work includes a vegetation type map which is of help as well as a rainfall map, the physiographic or geomorphic boundaries, and a topographic map. The topographic map is quite crude and is of almost no value. A very complete and thorough vegetation breakdown is provided.

677. Lee, Douglas H.K. ARID LANDS: ENVIRONMENTAL PHYSIOLOGY AND PSYCHOLOGY Science, v.140, no.3570 pp. 1002-07, May 31, 1963 DLC Q1.S35

Provides a summary report on a symposium sponsored by UNESCO and the Entral Drug Research Institute of India, at Lucknow, Dec. 7-13, 1962. The main theme of the symposium was the effect of enviromental factors in arid zones on the functioning of man' body and mind.

678. Littlefield, W.M. HYDROLOGY AND PHYSIOGRAPHY OF THE SALTON SEA, CALIFORNIA US Geol. Survey, hydrol. inv. atlas HA-222, scale 1:125,000, text, 1966

The Salton Sea occupies parts of Imperial and Riverside Counties, and lies below sea-level 125 mi northeast of the Gulf of California; the two bodies of water are separated by the Colorado River delta. In the geologic past

the sea was a part of the Gulf of California, and the Colorado River discharged alternately into the Gulf and the sea. The sea bed was a dry lake until irrigation was started in 1901 in the Imperial Valley; Colorado River floods increased its depth and volume until 1907 when water surface reached its maximum level, 195.9 feet below sea level. Since 1907 the water level has gradually receded as evaporation greatly exceeded inflow. Inflow occurs as rain and surface-and-ground-water flow; the latter is about 50,000 acre-feet per year. In 1962 salinity of the sea was 34,000 ppm.

679. Advanced Research Projects Agency, Project AGILE, Dept. of Defense OFF-ROAD MOBILITY RESEARCH 2nd semi-annual tech. rept., 9 February 1967-68, August 1967, US Army Research Office, Durham N.C. September, 1967

An interim summary of research and engineering studies being conducted in the area of off-road mobility is presented. These studies have been initiated as part of a long term plan which has the objective of augmenting knowledge and methods available to military planning, engineering and field personnel for purposes of improving ground mobility. These activities dealt with embrace the modeling of the human-vehicle-environment system and the detailed technical studies of soil mechanics, vehicle terrain interactions, human factor and environmental factors organic to the system. These technical studies are expected to provide quantitative inputs for mobility prediction and evaluation and form the basis for knowledgeable assessment of off-road mobility research.

680. Lobova, E.V. SOILS OF THE DESERT ZONE OF THE USSR (Pochvy pustynnoi zony SSSR.) Akad. nauk SSSR, Pochvennyi Institut im. V.V. Dokuchaeva, 1960, 362 pp., Translated by Israel Program for Scient. Translations, 1967 TT 67-51279

An excellent treatise with maps showing geomorphology, vegetation and soils relationships. The coverage includes soils and geography of the desert regions of the USSR, description of gray-brown soils and the taykrs and genetic properties of gray-brown soils.

681. Logan, Richard F. GEOGRAPHY OF THE CENTRAL NAMIB DESERT
In: Arid lands in perspective, ed. by Wm G. McGinnies
and B.J. Goldman. Washington, American Assoc. for the Advancement of Science, 1969, pp. 129-43, incl. graphs, maps, 13 ref. DLC S613.A7

The Namib Desert of the South West African coast is representative of the cool coastal desert type. Little affected by seasonality, its climate is cool and extremely damp all year at the coast, but markedly warmer and drier inland. The very scanty vegetation is strongly succulent near the coast, with grasses and nonsucculent bushes dominating the interior. Large areas are totally barren. Three regional units are recognized: the Coastal Namib, the area of strongly marine climate; the Namib Platform, an erosional surface (pediment) of extreme flatness cut by a few stream valleys and interrupted by widely scattered inselberge; and the Dune Namib, a vast sand-sea.

682. Logan, Richard F. POST-COLUMBIAN DEVELOPMENTS IN THE ARID REGIONS OF THE UNITED STATES OF AMERICA UNESCO, Arid Zone Res., No. 17 pp. 277-97, incl. ref., 1961

DWB (631.49 S783hi)

The present role of the arid western portion of the US in the national economy is outlined, the geographical location of the region under consideration is given and the landforms and the vegetation in this area are described. Other subjects considered are: history of exploration and settlement; rules of land ownership; General Land Office regulations; beginnings of conservation; acts of Congress (Taylor Grazing Act); role of the grazing industry; stabilization of ranching; technological advancement; extension of railway lines and eastern market demands; modern ranching techniques; dry farming and irrigation agriculture; laws governing surface and underground water rights; reclamation; economy of the desert Indian, etc.

683. Logan, R.F. A PROPOSED CLASSIFICATION OF THE GEOMORPHIC FEATURES OF THE ARID LANDS Soc. hellenique de geographie, bull., ser. 3, v. 4 pp. 100-03, 1963

Includes tables of landforms and map symbols.

(not seen)

684. Lowe, Charles H., Jr. CONTEMPORARY BIOTA OF THE SONORAN
DESERT: PROBLEMS Ariz., Univ. Arid Lands Colloquia,
1958-1959, pub. 1959, pp. 54-74

(not seen)

685. Lowe, C.H. and E.A. Halpern SUPERCOOLING OF THE SAGUARO
SPECIES DROSOPHILA NIGROSPIRACULA IN THE SONORAN DESERT
Ecology, v. 48 pp. 984-85, 1967 DLC QH540.E3

The ability to survive winter nocturnal temperature extremes makes it possible for the species to be active and breed throughout the winter over the geographical distribution of its primary host plant, the saguaro (Cereus giganteus), in Arizona and Sonora, Mexico.

686. Lowman, Paul D., Jr. PHOTOGRAPHY FROM SPACE GEOLOGIC APPLI-
CATIONS In: Planetary and Space mission planning. Sec.
1, Environments. New York Academy of Science, ann., v.140,
no.1 pp. 96-106, incl. photos, 1966 DLC Q11.N5

Several hundred terrain photographs were taken for geological study during the Gemini flights. Six reproduced here include five from the Mexico-United States border areas around the Colorado River, and one from Arabia. Structures rock types and geomorphology are interpreted.

687. Lumholtz, Carl and I.N. Cracopoli THE SONORAN DESERT, MEXICO
Geogr. jour., v.40, no.5 pp. 503-18, incl. illus., map
Nov. 1912 DLC G7.R91

A general description of the history and inhabitants of the area is followed by a description of the topography and flora. An interesting work from a historical point of view.

688. Lumholtz, K.S. NEW TRAILS IN MEXICO New York, Charles
Scribner's Sons, 1912, 411 pp. DLC F1346.L95

A narrative of an expedition into the Sonoran Desert, which is very typical of publications of this type and era. It contains usable information on Tinajas Altas, Los Medanos

dune along the Gulf of California), Pinicate lave fields, and a large dry lake, the Laguna Pierta. Descriptions of the vegetation of Sonora are also included. Although well illustrated, overall provides little that is not available in later publications.

689. Lustig, Lawrence K. THE GEOMORPHIC AND PALEOCLIMATIC SIGNIFICANCE OF ALLUVIAL DEPOSITS IN SOUTHERN ARIZONA -- A DISCUSSION (of paper by Mark A. Melton, 1965) Jour. geol., v.74, no.1 pp. 95-102, incl. illus., tables, 1966
REPLY: (by Melton). IBID: 102-104 DLC QE1.J8

Discusses the conclusions of Melton (ibid., v.73, pp. 1-38, 1965), who has applied the methods of quantitative geomorphology to the study of certain alluvial deposits in Arizona, and suggests that some of Melton's data are irrelevant and some conclusions may be wrong. In particular, he criticizes the conclusion that alluvial deposits containing boulders were deposited only during periods of intense frost activity, and points out that boulders reflect rock type and jointing first, and geomorphic processes second; conclusions on paleoclimatic or paleotectonic events do not follow directly from the study of boulder deposits. In his reply Melton repeats and amplifies the evidence given in his original paper (v.73, 1-38, 1965), and disagrees with the criticism given by Lustig.

690. Lustig, Lawrence K. COMPETENCE OF TRANSPORT OF ALLUVIAL FANS US Geol. Survey, Prof. Paper 475-C, pp. 126-29, 1963, 10 ref. DLC QE79.P9

The competence of transport on alluvial fans in Deep Springs Valley, California, is estimated by using a field approximation for tractive force based on maximum particle size and on slope. The distribution of tractive force is shown on isopleth maps together with an orthogonal net that represents inferred sediment-transport paths.

691. Lustig, Lawrence K. QUANTITATIVE ANALYSIS OF DESERT TOPOGRAPHY In: Arid lands in perspective. Washington, Amer. Assoc. for the Advancement of Sci., 1969, pp. 47-58, incl. illus., maps, 47 ref. DLC S613.A7

The quantitative analysis of desert topography may be approached from two aspects; analysis of specific landform types and regional topographic analysis. The study of

specific landform types generally consists of attempts to develop quantitative form parameters that define the geometry of a given feature and to relate these parameters to the natural processes that are operative on that feature. The methods employed and the degrees of success achieved are illustrated by outlines of the treatment to date of alluvial fans, headland-bay beaches, barchan dunes, and river meanders. The form parameters involved include polynomial equations, the logarithmic spiral, the ellipse and parabola, and the sine-generated curve. Regional analysis, the contract, involves attempts to define terrain parameters that may be used to map regions and to determine degrees of similarity or distinctiveness between or within large areas. This approach to treating desert topography is discussed with respect to several schemes of terrain classification and illustrated by discussion of an analysis of the Basin and Range province by trend-surface methods.

692. Lutton, Richard J. A LENSOIDAL RHYOLITE NEAR TWIN BUTTES, ARIZONA Ariz. geol. soc. dig., v.4 pp. 43-47, incl. illus., table, map, Nov. 1961 DLC unbound

Pectinate (or axiolitic) structure is remarkably well-developed in a volcanic rock at the southeast end of the Sierrita Mountains, Pima County, Arizona. The host rock, a lensoidal rhyolite, is one unit of a series of sedimentary and volcanic formations. In the immediate area about 1,000 feet of the Cretaceous (?) section can be subdivided into six members. Only the upper two are of concern here.

693. Langbein, Walter B. SALINITY AND HYDROLOGY OF CLOSED LAKES US Geol. Survey, Prof. paper 412, 20 pp., incl. illus., tables, 1961, 38 ref. DLC QE75.P9

Closed lakes are exclusively features of the arid and semi-arid zones where annual evaporation exceeds rainfall. The number increases with aridity, so there are relatively few perennial closed lakes, but "dry" lakes that rarely contain water are numerous. Closed lakes fluctuate in level to a much greater degree than the open lakes of the humid zone, because variations in inflow can be compensated only by changes in surface area. Since the variability of inflow increases with aridity, it is possible to derive an approximate relationship for the coefficient of variation of lake area in terms of data on rates of evaporation, lake area,

lake depth, and drainage area. The salinity of closed lakes is highly variable, ranging from less than 1% to over 25% by weight of salts. Some evidence suggests that the tonnage of salts in a lake solution is substantially less than the total input of salts into the lake over the period of existence of the closed lake. This evidence suggests further that the salts in a lake solution represent a kind of long-term balance between factors of gain and loss of salts from the solution. Possible mechanisms for the loss of salts dissolved in the lake include deposition in marginal bays, entrapment in sediments, and removal by wind. Transport of salt from the lake surface in wind spray is also a contributing, but seemingly not major factor. The hypothesis of a long-term balance between input to and losses from, the lake solution is checked by deriving a formula for the equilibrium concentration and comparing the results with the salinity data. The results indicate that the reported salinities seemingly can be explained in terms of the geometric properties and hydrologic environment. The time for accumulation of salts in the lake solution -- the ratio between mass of salts in the solution and the annual input -- may also be estimated from the geometric and hydrologic factors, in the absence of data on the salt content of the lake or of the inflow.

694. Mabbutt, J.A. LANDFORMS OF THE WESTERN MACDONNELL RANGES: A STUDY OF INHERITANCE AND PERIODICITY IN THE GEOMORPHOLOGY OF ARID CENTRAL AUSTRALIA In: G.H. Dury (ed.) Essays in geomorphology. London, Heinemann, 1966, pp. 83-119, 17 ref. DLC GB7.D8

Features as relict weathered profiles, truncated river systems and vegetated sand dunes testify to important climatic change. The upland surface of the MacDonnells has now been shown to be the product of more than one period of erosion. It is not a simple summit plain but extensive crest bevels and gentle upper slopes show that it is real enough. The crest bevels are believed to result from partial planation, the gentle slopes from a later (and lower) stage of valley formation. The smooth slopes suggest a more humid climate than today, supported by deep weathering (including desilification) and remnant corestones. Within the valleys, five elements are identified: high terrace, middle terrace, low terrace, colluvial aprons and flood plains. The high terrace grades to the summit surface and is also lateritically-weathered. The irregular basal surface of this weathered zone has been exhumed in places and its form strongly influences the present landscape. The middle terrace is less steep than the high terrace so they converge downstream.

The low terrace below it has red soils; those on younger alluvial material are red-brown or grey-brown. The present floodplains show long-continued aggradation with fills of 60 feet or more. The terrace sequence is interpreted in terms of a cycle of climatic change. Under wetter conditions the streams incise and slopes are covered in vegetation, so promoting stability. With drier conditions streams would change from incision to planation, and increasing drought would eventually lead to a deterioration of the vegetation cover on the slopes and extensive slope erosion. These climatic shifts seem to have been superimposed on a secular tendency to increasing aridity and the successive weathering profiles are shallower. The strongly discordant drainage has been claimed as antecedent, superimposed, or inherited from an erosion surface without superimposition. While inheritance seems likely for much of the ranges, capture resulting from regressive erosion by steep streams is believed to have operated in part of the western MacDonnells.

695. Mabbutt, J.A. and M.E. Sullivan THE FORMATION OF LONGITUDINAL DUNES: EVIDENCE FROM THE SIMPSON DESERT Austral. geog. v.10, no.6 pp. 483-87, incl. illus., 14 ref., 1968
DLC

Two extreme explanations for the formation of longitudinal dunes, one -- the accumulation of aeolian sand over pre-existing surfaces, and two -- residuals from wind excavation of interdune hollows, are examined for two sites in the Simpson Desert. King's hypothesis favouring the second explanation, and based upon observations southeast of Lake Eyre, is not supported by evidence from the northwest of the Simpson Desert. The sub-aeolian surface is there level both under swale corridors and dunes, and the aeolian accumulation appears the more likely explanation.

696. MacDougal, D.T. THE DESERT BASINS OF THE COLORADO DESERT Amer. geogr. soc., bull., v.39 pp. 705-29, 1907
DLC G1

An account of the then, recently filled Salton Sea with a description of similar lakes in Mexico.

697. MacDougal, D.T., and others THE SALTON SEA, A STUDY OF THE GEOGRAPHY, THE GEOLOGY, THE FLORISTICS, AND THE ECOLOGY OF A DESERT BASIN Carnegie Inst. of Wash., Pub. 193, 1914 DLC

The geology presented is chiefly a summation of previous studies; the plant studies are detailed and were considered valuable in their time.

698. MacPhail, Donald D. REGIONAL SETTING In: Hodge, C. & P. Duisbert (eds.), Aridity and man, Wash., Amer. Assoc. Advanc. Sci., Pub. No. 74, 1963 pp. 11-53, 18 ref. DLC GB614.A5

Aridity is an expression of water deficiency. Water deficiency is induced not only by lack of precipitation, but also by conditions of soil moisture and permeability, evaporation, transpiration by plants, and the intensity and duration of sunlight, heat, humidity, and wind. This statement is followed by a discussion of characteristics of aridity where it is pointed out that in a given year, semiaridity may extend as far east as western Wisconsin, northwestern Iowa, and western Louisiana. What the eastern boundary of the Short-Grass Plains does indicate is the prevalence of drought. The effects of rainfall, zonal soils and western vegetation are then considered and it is concluded that when the available facts are analyzed, the physical and cultural landscapes are easily grouped into several regions. The major phytogeomorphic regions (Pacific valleys and mountains, Intermountain region, Rocky and Sacramento Mountains, and Short Grass Plains), each subdivided into two or more sub and sub-sub-regions, are shown on a map of the western U.S. Of the regions, the Pacific valleys, the Sagebrush, and the Creosote Bush zones of the Intermountain region, the Rocky

and Sacramento Mountain region and the Tropical Arid zones, which include leeward Hawaii and leeward Puerto Rico, are discussed in detail. Climatic records are tabulated for the Pacific valleys and for the Sagebrush zone. Illustrations include maps of the great soil groups, of major land uses, of mean daily maximum temperatures in July and of problem lands which are too mountainous, rough, sandy or clayey for full agricultural use.

699. Maderey, R. and E. Laura GEOHYDROLOGICAL MAP, MEXICO (Mapa geohidrologico de Mexico) In: International Geographical Union, Latin American Regional Conference, Mexico, 1965, Proceedings, vol. 3. Mexico, D.F., Soc. Mexicana geogr. y estadistica, 1966, pp. 423-35 DLC G2.I5

Based on principles adopted from Meinzer (1925) and factors suitable for the presence of ground water, as indicated on given maps of precipitation, physiography, geology and vegetation, Mexico is divided into 14 hydrogeologic regions; north central, and southern zones of Baja California; northern high plains and Pacific coastal plains; Sierra Madre Occidental and cross ranges of volcanic rocks; coastal plains of Sinaloa, Nayarit, and part of Sonora; Sierra Madre Oriental and zone northeast of the high plains chiefly Cretaceous limestones; Gulf of Mexico coastal plain; Sierra Volcanica Transversal and south of the high plains; Sierra Madre del Sur and Pacific coastal zones of nearby states; Balsas-Tepalcatepec basin; zone southeast of Mexico; Sierra Madre and coast of Chiapas; and Yucatan Peninsula.

700. Mallery, T.D. RAINFALL RECORDS FOR THE SONORAN DESERT Ecology, v.17, no.1 pp. 110-21, incl. illus., tables, map, January 1936, 7 ref., and, v.17, no.2 pp. 212-15, April 1936 DLC QH540.E3

In 1925, an extensive investigation of rainfall on the Sonoran Desert was begun. A series of long-period Sykes rainfall gauges were installed in Arizona and Sonora. Records from the Sonoran stations (covering a period of 7-10 years) ranged from 4.03 at Puerto Libertad, Sonora, to a maximum of 16.33 at Baboquivari. Brief descriptions of the vegetation and topography of each of the Sonoran rain gauge sites is included. In the second part of the article, complete data on rainfall for the Sonoran Desert is summarized to December 1935.

701. Mandarino, Joseph A. and Scott J. Williams FIVE NEW MINERALS FROM MOCTEZUMA, SONORA, MEXICO Science, v.133, no.3469, pp. 2017, June 23, 1961, 2 ref. DLC Q1.S35

Five new minerals have been found in a Te deposit near the town of Moctezuma, Sonora, Mexico. Preliminary study shows that they are a lead-oxy-fluoride, a zinc tellurite or tellurite, a manganese-zinc tellurite or tellurate, a manganese tellurite or tellurate, and an iron tellurite or tellurate.

702. Mann, J.F., Jr. THE SIGNIFICANCE OF THE SUB-ALLUVIAL OUTCROP IN ARID AND SEMI-ARID REGIONS Internatl. geol. cong., 20th, Mexico, 1956, proc., Sect. 4 pp. 55-73, incl. illus., tables, refs., 1957 DLC QE1.I6 1956b

In arid and sub-arid regions aquifers whose outcrops may be exposed over large areas are only infrequently recharged directly by rainfall. The soil moisture deficiency usually aggregates more than the amount of rain falling in any ground water. Where these aquifers crop out in washes, however, there is probably some recharge for short periods during which the wash contains a flowing stream. A most favorable recharge situation is found where the aquifer outcrop is crossed by a layer of alluvium, which may remain saturated long after the floods. This last condition is referred to as the "sub-alluvial outcrop." Examples are given of many types of geological situations in which more or less continuous recharge through sub-alluvial outcrops takes place. Effective ground water development in the vicinity of sub-alluvial outcrops may result in the following advantages: (1) making a saline aquifer usable by following flushing with fresh water; (2) allowing a greater rate of extraction from the underground basin; (3) salvage of the otherwise rejected natural recharge; (4) increasing available storage volume for water artificially recharged by spreading; (5) increasing the safe yield; (6) better location of wells designed to tap fracture systems recharged by saturated alluvium.

703. Marescaux, G. THE RESISTANCE OF IRON OXIDES AND SILICA TO EROSION IN ARID MAURITANIA (Sur la resistance a l'erosion des oxydes de fer et de la silice en Mauritanie aride.) Text in French. Assoc. geogr. Francaise, bull., no. 366/367 pp. 239-48, incl. illus., ref., 1968 DLC

The degree of relative resistance of magnetite, silica and haematite to erosive process in arid climates have been measured by field investigation in six areas of Mauritania. Results confirmed magnetite to be the least resistant of the three and haematite the most resistant. Chemical composition, rock bedding and grain size are discussed as explanatory factors. It is considered desirable to compare such results with information from other regions, especially Australia.

704. Mauger, Richard L. A PETROGRAPHIC AND GEOCHEMICAL STUDY OF SILVER BELL AND PIMA MINING DISTRICTS, PIMA COUNTY, ARIZONA -- PhD thesis, 1966, 156 pp. Order from: Univ. Microfilms, Ann Arbor, Mich., No. 66-10, 197: mf \$3.00; ph \$7.50

Mid-Tertiary and Laramide K-Ar ages were measured on igneous rocks from Silver Bell and Esperanza. The ages from barren and mineralized Laramide rocks were identical within experimental error. Mineralization is restricted to the cooling-crystallization history of the associated porphyry. At Silver Bell, erosion and enrichment probably occurred during the Laramide to mid-Tertiary interval. The igneous rocks, quartz monzonites, consist of quartz, chalcopyrite, and accessory minerals. The porphyry groundmasses are chemically equivalent to a class of naturally occurring, potash-rich pitchstones. Pyrite and chalcopyrite occur separately or jointly as disseminations and in small veinlets. Associated minerals include orthoclase, albite, epidote, chlorite, muscovite, quartz, apatite, clacite, and barite. Open space occurs with the sulfides. The mineralized veinlets fall into classes with particular mineral assemblages and associated wallrock alteration effects.

705. Mauger, Richard L., Paul E. Damon and Donald E. Livingston CENOZOIC ARGON AGES ON METAMORPHIC ROCKS FROM THE BASIN AND RANGE PROVINCE Amer. jour. sci., v.266, no.7 pp. 579-89, summer 1968 DLC Q1.A5

In the Basin and Range Province, mid-Tertiary K-Ar mica ages have been measured from metamorphic rocks that, on the basis of stratigraphic and other isotopic evidence, originated at some earlier time. The young argon ages indicate that these rocks underwent an episode of heating prior to uplift during Basin and Range faulting, an event that led to final cooling and argon retention in these rocks. The K-Ar ages and large volumes of volcanic rocks both indicate that widespread crustal heating occurred in the Basin and Range Province during Tertiary time. In the Catalina Mountain block ten of fourteen mica and feldspar K-Ar ages are between 25 and 30 m.y. The remaining four very coarse-grained high-potassium muscovites show older ages and presumably had greater retentivity for argon than the finer grained samples. Among the coarse-grained muscovites, radiogenic argon is excess of that expected for a 26 m.y.-old mineral increases with topographic elevation.

706. Maxey, George B. HYDROGEOLOGY OF DESERT BASINS Ground water, v.6, no.5 pp. 10-22, Sept.-Oct. 1968, incl. illus., maps, ref. DLC GB1001.G75

In the Great Basin two general categories of ground water flow systems are recognized: (1) local flow systems where drainage areas are small, flow paths are relatively short, interbasin flow is uncommon, springs have large variations in discharge, and water temperature and Na, K, Cl, and SO_4 concentrations are low, and (2) regional flow systems, where drainage areas are large, flow paths long, interbasin flow common, springs have large discharge, and water is usually higher in temperature and K, Na, Cl, and SO_4 concentrations. Hydrologic approaches used, in addition to conventional methods, include hydrologic budget, water potential, and water chemistry studies. Although detailed delineation of most flow systems in Nevada has not been accomplished, integration of hydrologic, geologic, and chemical methods allow approximate portrayal of many systems, both local and regional.

707. Maxey, George B., and R.N. Farvolden HYDROGEOLOGIC FACTORS IN PROBLEMS OF CONTAMINATION IN ARID LANDS Ground water v.3, no.4 pp. 29-32, 1965 DLC GB1001.G75

The ideal hydrologic system in arid lands includes a recharge area in mountains and a discharge area in lowlands, a system modified in nature by geologic and physiographic factors. Population and agricultural activity concentrates in valleys, usually in zones of ground water discharge. Most water-supply, contamination and disposal problems arise from this combination of features. The suitability of hydrogeologic units for any function of operations involving water supply or waste disposal depends primarily on their position within the hydrologic system and secondarily on physical properties. For example, at the Nevada Test Site the ground water flow system is used to good advantage, whereas at Las Vegas, 70 miles away, the methods of disposal practiced are in direct conflict with the systems.

708. McCoy, Floyd W., Jr., Warren J. Noklesberg and Robert M. Norris SPECULATIONS ON THE ORIGIN OF THE ALGODONES DUNES, CALIFORNIA Geol. soc. Amer., bull., v.78, no.8 pp. 1039-44, incl. graph, map, Aug. 1967, 15 ref. DLC QE1.G2

The Algodones dune belt, which lies on the southeastern border of the Imperial Valley, represents a coastal dune system probably derived from the shore lines of fresh

water and marine inundations of the Cahuilla Basin. The estimation of the volume of sand in the dune belt is 380,000 million cubic feet. Assuming climatic conditions similar to those of today existed during formation of the dune belt, computations of wave regimen and resultant longshore currents showed that fresh water and marine inundations of the basin aggregating a minimum of 160 thousand years would be required to provide and transport this volume of sand from the source areas to the present site of the dunes. Inundations of the Cahuilla Basin during part of the Pleistocene as well as Recent are necessary for such a formation as the dune belt.

709. McDonald, James E. VARIABILITY OF PRECIPITATION IN AN ARID REGION: A SURVEY OF CHARACTERISTICS FOR ARIZONA Ariz. Univ. Inst. Atmos. Phys., Tech. repts. on meteorol. & clim. of arid regions, No. 1, 88 pp., incl. tables, graphs, maps, ref., Dec. 31, 1956 DLC QC993.7.T4

Report has summarized a number of pilot studies carried out as one preliminary phase of an extended Institute program of investigation of variability of precipitation for Arizona and for arid regions in general. From an examination of seasonal and annual coefficients of variation it was concluded that there is a surprising difference in temporal variability of winter and summer Arizona precipitation, the wintercyclonic precipitation coefficients being higher (by statistically significant amounts) than the coefficients for summer thunderstorm precipitation for all but the driest portions of the state. Despite greater temporal winter variability, it was found from correlation analyses that the winters are characterized by significantly lower spatial variability in Arizona, an unexpected combination of conditions.

710. McGee, W.J. SHEET FLOOD EROSION Geol. Soc. Amer., bull., v.8 pp. 87-112, 1897 DLC QE1.G2

Good description of the arid Sonoran Desert. Pages 89-91 state: "To the casual observer traversing its expanse it seems a region of mountains, for rugged buttes, mesas, and sierras are always in sight and usually dominate the landscape; but more careful observation shows that it is

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primarily a plains region, since fully $\frac{4}{5}$ of its area consists of plains, hardly $\frac{1}{5}$ mountains. . . . By reason of heat and aridity the Sonoran District is desert or sub-desert throughout; the vegetation is too scant, stunted, and scattered to protect the surface from storms. . . . At first sight the Sonoran district appears to be one of half-buried mountains, with broad alluvial plains rising far up their flanks, and so strong is this impression on one fresh from humid lands that he finds it difficult to trust his senses when he perceives that much of the valley plain is not alluvium but planed rock similar to or identical with that constituting the mountains. This is the striking characteristic of the Sonoran region -- the mountains rise from the plains, but both mountain and plain (in large part) are carved out of the same rocks. The valley interior and lower lowlands are, indeed, built of torrent-laid debris, yet most of the valley area carries but a veneer of alluvium so thin that it may be shifted by a single great storm. Classed by surface, $\frac{1}{5}$ of the area of the Sonoran district, outside of the Sierra and its foothills, is mountain, $\frac{4}{5}$ plain, but of the plain something like one-half or $\frac{2}{5}$ of the entire area, is planed rock leaving only a like fraction of thick alluvium."

711. McGehee, Ralph M. WEATHER: COMPLEX CAUSES OF ARIDITY In: Hodge, C. & P. Duisberg (eds.), Aridity and man, Wash., Amer. Assoc. Advance. Sci., Pub. No. 74, 1963, pp. 117-43, 25 ref. DLC GB614.A5

The author states that: (1) precipitation in arid regions usually is highly variable and, consequently, is unreliable; (2) conditions that decrease the amounts of precipitation or increase the need for precipitation, or both, cause increases in aridity; (3) the principal causes of aridity are large scale and persistent. Climates are also affected by such factors as the locations and sizes of the continents. The wind belts control much of the climate, and determine the major wet and dry areas of the world. Places in the belts of descending air, in the lee of mountain chains, and near cold ocean currents, all are likely to have arid conditions. The world major arid and semiarid regions and cold ocean currents are shown on a map. This is followed by a discussion of aridity in the U.S. illustrated by a chart of mean monthly precipitation.

712. McGinnies, William G. and Bram J. Goldman (eds.)
ARID LANDS IN PERSPECTIVE: INCLUDING AAAS PAPERS ON
WATER IMPORTATION INTO ARID LANDS Wash. Amer. Assoc.
for the Advancement of Science; Tuscon, Univ. of Ariz.
Press, 1969, 421 pp. DLC S613.A7

A collection of articles compiled under the leadership of the Advisory Committee for Arid Lands of the University of Arizona and the Committee on Arid Lands of the AAAS, which summarizes aspects of current research and knowledge relevant to the habitation of the warm arid areas of the world. Articles relevant to this project and abstracted separately are the following: Playa variation, by James T. Neal; Quantitative analysis of desert topography, by Lawrence K. Lustig; The news system of soil classification as applied to arid-lands soils, by Klaus W. Flach and Guy D. Smith; Geography of the Central Namib Desert, by Richard F. Logan; Formation of deserts of the Near East and Northern Africa, by Robert L. Raikes; Arid-Land studies in Australia, by C.S. Christian and R.A. Perry; Bibliographic sources for arid-lands research by Patricia Paylore; and, Arid-lands knowledge gaps and research needs, by Wm. G. McGinnies.

713. McGinnies, William G., Bram J. Goldman and Patricia Paylore (eds.)
DESERTS OF THE WORLD: AN APPRAISAL OF RESEARCH INTO THEIR
PHYSICAL AND BIOLOGICAL ENVIRONMENTS Tucson, University
of Arizona Press, 1968, 788 pp., incl. maps, biblios.
DLC GB12.D4

The formal publication that resulted from the Inventory of Geographical Research on Desert Environments. Individual abstracts separately included.

714. McGinnies, William G. and James W. Meadows Jr. INTRODUCTION
Chapter I. An inventory of geographical research on desert
environments. Arizona. Univ. Inst. of Arid Lands Studies,
1968, 22 pp., 11 ref. (U.S. Army Natic Labs., TP 376)

A general description of deserts is followed by a series of locator maps (based on Meigs) of the arid lands of the world. Thirteen major desert areas are recognized: Kalahari-Namib, Sahara, Somali-Chalbi, Arabian, Iranian, Thar, Turkestan, Takla-Makan, Gobi, Australian, Monte-Patagonian, Atacama-Peruvian, and North American. In the remainder of the chapter, these desert areas are briefly discussed as to location, climate, and landscape features including topography, soils and vegetation.

715. McKee, Edwin D. STRUCTURES OF DUNES AT WHITE SANDS NATIONAL MONUMENT, NEW MEXICO (AND A COMPARISON WITH STRUCTURES OF DUNES FROM OTHER SELECTED AREAS) Sedimentology, v.7, no.1 spec. issue, 69 pp., incl. illus., tables, 1966
DLC QE471.S4

The type, scale, and relative abundance of sedimentary structures in dome-shaped, transverse, barchan, and parabolic dunes in this area were determined from wall sections of trenches cut through them at right angles and in a windward direction. Common features include medium to large-scale sets of cross-strata; downwind dip of laminae at high angles; bounding surfaces between sets nearly horizontal on upwind side, but steepening to lee; individual sets thinner and laminae flatter nearer the top than at bottom of dune. Sparse but distinctive features are described also. In terms of three dimensions, tabular planar sets are dominated with units thickest near the dune base. Dunes characteristic of one wind direction are compared with the multidirectional wind forms such as seif dunes of Libya, reversing dunes of Colorado, and star dunes in Saudi Arabia.

716. McKee, E.D. SEDIMENTARY BASINS OF ARIZONA AND ADJOINING AREAS Geol. soc. amer. bull., v.62, no.5 pp. 481-505, May 1951
DLC QE1.G2

An analysis has been made of the thickness of sediments accumulated in various parts of Arizona and adjoining areas during each of the periods of geologic history. From these and other sedimentary data, conclusions are drawn concerning the times and places of crustal movement in the region. For the Paleozoic and Mesozoic eras, data have been compiled, period by period, in the form of isopach maps. For the Cenozoic era, information on thickness of sediments in individual basins is shown on a base map. Five basic structures appear in Arizona in all of the Paleozoic maps. These consist of 2 positive areas (in the NE and SW respectively), the margins of two geosynclines (in the NW and SE), and a sag in central Arizona between the positive areas and connecting the 2 geosynclines. Prongs or submarine ridges extending basinward from the positive areas, and areas of more rapid sinking between them, appear to have shifted position from time to time. Four major changes in isopach pattern are noted and briefly described.

717. McKee, Edwin D. ARIZONA AND WESTERN NEW MEXICO U.S. geol. survey, prof. paper 515, pp. 199-223, incl. illus., table, 1967 DLC QE79.P9

History of the Permian in this area is analyzed on the basis of thickness lithology, and other mappable features. At the beginning of the period the land surface was low but very irregular. There were six principal basins bordered by positive elements of older rocks, inherited from Pennsylvanian time. During earlier Permian time, interval A, influxes of sediment largely from the North, filled depressions between the positive areas with thick deposits, thereby restricting marine invasion and burying topographic features. Interval B indicates deposition on a flat surface of uniform thicknesses of sediment which formed great wedges of strata thickening southward. Interval C is unrepresented in most parts of the region.

718. McKee, Edwin D., Richard F. Wilson, William J. Breed, and Carol S. Breed (eds.) EVOLUTION OF THE COLORADO RIVER IN ARIZONA: A HYPOTHESIS DEVELOPED AT THE SYMPOSIUM OF CENOZOIC GEOLOGY OF THE COLORADO PLATEAU IN ARIZONA, AUGUST 1964. Museum of Northern Ariz. bull., v.44, 67 pp., incl. illus., 149 ref., 1967 DLC

Describes five very generalized stages extending from latest Mesozoic through Cenozoic time. During Stage 1, drainage in northern Arizona was toward the regressing Cretaceous seas to the east and northeast across a gently sloping alluvial plain. During Stage 2 several monoclinical structures developed in northern Arizona, and the southwestern margin of the Colorado Plateau area was elevated. Extensive erosion and bevelling is inferred to have taken place in northwestern Arizona; drainage directions were probably northeast and north toward the Eocene lakes in central Utah. Events during Stage 3 include renewed uplift and erosion in northwestern Arizona, initial movement on post-Laramide faults, and an uplift beyond the present northern margin of the Colorado Plateau in central Arizona -- the Central Arizona Mountains. Gravels derived from this uplift were spread northward onto what is now the southern portion of the Plateau. Drainage in northern Arizona during this stage seems to have involved two discrete systems; one in northwestern Arizona, here called Hualapai drainage system; and one in the northeastern Arizona, designated the ancestral upper Colorado drainage system. The Hualapai system

seems to have drained westward or possibly south-westward from the general area of the Hualapai Plateau. The ancestral upper Colorado system seems to have drained southward and south-eastward into northeastern Arizona from southeastern Utah. The two systems were probably separated by the Kaibab upwarp, which served as a drainage divide. Stage 4 followed deposition of the early gravels derived from the Central Arizona Mountains and preceded establishment of the present Colorado River drainage patterns in northern Arizona. Events during this stage included the deposition of ponded or interior basin deposits in several places in northern Arizona, the widespread eruption of lavas on and adjacent to the southern margins of the Plateau, renewed faulting, and probably the continued separation of the Hualapai and the ancestral upper Colorado drainage system. Stage 5 -- the establishment of the modern Colorado River drainage pattern -- began sometime in the Pliocene and has continued to the present. The modern pattern was probably established through the diversion of the ancestral upper Colorado system into the Hualapai system across the southern part of the Kaibab upwarp. This diversion probably took place between 2.6 and 10.6 million years ago.

719. Brooks, Wahner THE INFLUENCE OF TERRAIN ON DESERT ENVIRONMENTAL TESTING. Yuma Proving Ground Test and Evaluation Directorate, Test Methodology and Instrumentation Office, April 1968, Tech. Mem. MI-9-68

A complete desert environmental test must include the effects of the terrain. Following brief discussions of deserts and desert types, the components of the desert are described quantitatively. Testing requirements are then specified in terms of these components and soil parameters. Materiel considered includes weapons, ammunition, missiles and rockets, aircraft armament, electronic equipment, construction equipment and quartermaster items. Recommendations include test sites and courses at Yuma Proving Ground.

720. Meda1, Sheldon E. A PETROGRAPHIC STUDY OF A DESERT FANGLOM-
ERATE Compass, v.39, no.2 pp. 77-85, incl. illus.,
Winter 1962, 11 ref. DLC TN1.C793

Extending easterly from the crest of New York Mountains (California) is a lithified alluvial fan deposit or fanglomerate. The fanglomerate is stratified, well cemented in part, and contains rounded cobbles and pebbles of marble, andesite, gneiss, and quartz monzonite. Marble, the softest of the 4 rock types studied, attains the highest degree of roundness whereas the gneissic rocks, due to fracturing along foliation planes, are the least rounded. Andesite attains the highest degree of sphericity of the rock types studied, probably as a result of its hard, finely crystalline nature. Quartz monzonite, which is coarsely crystalline, has a sphericity value second to andesite. Gneiss has the lowest sphericity value because its sphericity is governed by the width of the closely spaced foliation planes. The matrix of the fanglomerate has a composition which ranges from 19 to 66% feldspar, or from a feldspathic sandstone to an arkose. Portions of the matrix are comparatively well sorted in contrast to the sorting which is commonly accepted for fanglomerates. The cement is caliche. Although this lithified alluvial deposit differs from the classical definition of fanglomerate, it unquestionably is a fanglomerate. All evidence indicates it was derived from the New York Mountains, probably during Pleistocene time. This leads to the conclusion that the term fanglomerate should not be limited in any respect as to texture, sorting, or roundness of its constituents.

721. Medina, Francisco MONOGRAPH OF SONORA (Monografia de Sonora)
Text in Spanish. Mexico, D.F., Talleres Topograficos
Modelo, 1941, 193 pp. DLC F1346.M4

This work provides a broad-based description of the geography, botany, physiography, hydrology, industries, etc. of the state of Sonora. Although most is of an elementary nature, there are important and useful portions and maps.

722. Meigs, Peveril GEOGRAPHY OF COASTAL DESERTS Paris, UNESCO, Arid Zone Res. 28, 1966, 140 pp., incl. illus., maps, ref. \$6.50 DLC GB612.M4

This report on the "geographical potentiality" of the world's coastal deserts presents a broad view of the world distribution and types of coastal deserts, their present and possible utilization, and extensive references for more detailed study. Part 1 deals with the general aspects of coastal deserts and includes the following: the distinctive characteristics of coastal deserts, their limits, classification and their potential uses -- agriculture, grazing, minerals, fish, seaweed, salt, recreation, trade, tidal power, and sun and wind. Part 2 is a regional survey and contains a description of the principal natural characteristics (climate and terrain) and types of land use for each sector of the coastal deserts. Climatological data including mean temperature, mean daily maximum and minimum temperature, mean cloudiness, and mean precipitation for each of the coastal deserts and map of the various deserts are given.

723. Meigs, Peveril ARID AND SEMIARID CLIMATIC TYPES OF THE WORLD Internatl. geol. cong., 17th, Wash., D.C., August 1952, Proc., (1956?) pp. 135-38, 8 ref. DLC G56.I58

The author describes the basis used to construct maps delimiting and subdividing the dry climates. The precipitation divisions are based upon Thornthwaite's classification system. In turn, the areas thus obtained are subdivided according to the tempercline (mean temperatures of the coldest and warmest months).

724. Melton, Mark A. ORIGIN OF DRAINAGE OF SOUTHEASTERN ARIZONA Ariz. geol. soc., digest, v.3 pp. 113-22, 8 ref., 1960 DLC unbound

The drainage history of desert basins does not necessarily begin with uplift of mountains and formation of undrained basins. In the Safford Valley, Graham County, a preexisting drainage system was able to maintain itself throughout the mountain-building epoch and was disrupted, not by diastrophism, but much later by capture by structurally favored tributaries. Desert basin fills are not necessarily entirely the product of erosion of the bounding mountain ranges. At times, erosion in the mountains is sufficiently slow to allow rivers to import fine-grained material and deposit it next to the mountain front. The cause of deposition of the "lake sediments" in the Safford Valley was related to the accidental coincidence of the mouth of the major drainage with a center of volcanism that raised the base level of the entire system.

725. Mendenhall, W.C. COLORADO DESERT Natl. geogr. mag., v.20
pp. 681-701, 1909 DLC G1.N27

Gives an early, but very good account of the geologic evolution of the Colorado Desert of California and Baja California. Features and landforms of geologic significance described in detail and located. No maps, however, 16 photographs illustrate physiography and landforms.

726. Merriam, Richard SOURCE OF SAND DUNES OF SOUTHEASTERN CALIFORNIA AND NORTHWESTERN SONORA, MEXICO Geol. soc. Amer. bull., v.80, no.3 pp. 531-34, March 1969 DLC QE1.G2

Extensive dunes of southwestern California and northwestern Sonora, Mexico, were derived mainly from Cenozoic Colorado River delta sediment. All dune sand and sandy delta sediment have K-feldspar in excess of plagioclase, abundant volcanic fragments, detrital Cretaceous Foraminifera, and abundant detrital calcite and dolomite. Sands derived from local crystalline bedrock and carried by the Whitewater River and major washes entering the Salton Basin lack these features.

727. Merriam, Richard SAN JACINTO FAULT IN NORTHWESTERN SONORA, MEXICO Geol. soc. amer. bull., v.76, no.9 pp. 1051-54, incl. illus., 1965 DLC QE1.G2

Pleistocene and Recent delta sediments east of the mouth of the Colorado River are cut by a zone of faults believed to be a continuation of the San Jacinto fault of California. The northeast side is elevated and a small amount of right-lateral displacement has occurred.

728. Metzger, D.G. A MIOCENE (?) AQUIFER IN THE PARKER-BLYTHE-CIBOLA AREA, ARIZONA AND CALIFORNIA U.S. Geol. surv. prof. paper 525-C, pp. C203-C205, incl. illus., table, 1965 DLC QE75.P9

A fanglomerate which is a potentially important aquifer has been identified in outcrops and in wells near Parker, Blythe, and Cibola, in the Colorado River Valley in California and Arizona. The fanglomerate, believed to be of Miocene age, is buried beneath Pliocene (?) estuarine deposits, and beneath younger deposits of the Colorado River, at most places where it is known. It is hydraulically

separated from surficial river diposits by clay beds in the estuarine deposits, and the water level in several wells stands above the water table. The water is suitable chemically for irrigation, although its fluoride content makes it unsuitable for domestic water supply.

729. Mexico. Comite de la Carta Geologica de Mexico
GEOLOGICAL MAP OF MEXICO (Carta geologica de la Republica Mexicana) Prepared by Williams & Heintz Map Corp. Wash., D.C. Scale 1:2,000,000, size: 46½ X 64 in., 1968
Copies available from: Comite de la Carta Geologica de Mexico, Ing. Guillermo P. Salas, Pres., Ciudad Universitaria, Mexico 20, D.F., Mexico

730. Miller, Halsey W. and Karl W. Schwab MICROFOSSILS FROM THE UPPER CRETACEOUS OF ADOBE CANYON, SOUTHERN ARIZONA Ariz. geol. soc. dig., v.8 pp. 65-95, Dec. 1966, 38 ref.
DLC unbound

Upper Cretaceous sediments from Adobe Canyon, located in the southeastern foothills of the Santa Rita Mountains of Arizona, contain a varied microfauna and microflora. Evidence for Late Cretaceous erosion of lower Plaeozoic rocks in Southern Arizona is presented. Micro-vertebrates include teeth of Gyrodon?, an unidentified amioid fish, and reworked ostracoderm plate fragments. Micro-invertebrates include the mollusks Sphaerium sp. of cf. S. formosum Meek and Hayden, Corbicula sp., Graulus sp., and Gonobasis sp.; an ostracode, Cypridopsis; an unidentified mosquito, an insect claw, problematical amber spheres; the hystri-chomorphs Leiosphaeridia spp., Baltisphaeridium spp., Veryhachium sp. cf. V. trispinosum Eisenack, Hystri-chosphaeridium spp., and Pterospermopsis? sp.; two reworked chitinozoans, Sphaerolithina sp., and Hoegispharea sp.; the charophytes Stellatochara mundula Peck, Aclistochara sp. cf. A. bransoni Peck, and Mesochara voluta Peck; the palynomorphs Punctatisporites sp., Cyclogranisporites sp., Acanthotriletes sp., Aequitriradites? sp., Monosulcites sp., Ginkgoetectina? sp., Anemidites? sp., and Labia-densites? sp., also present are remains of the fungus Pluricellaersporites sp. cf. P. psilatus Clarke.

731. Milton, W. Bryan ACOUSTICAL SAND Compass, v.38, no.2
pp. 99-105, January 1961, 27 ref. DLC TN1.C793

Sands possessing acoustical properties have been described from all over the world. The sands have been given many different names; for the sake of simplicity and organization, the writer proposes the name "acoustical sand." Acoustical sand is found only in 2 types of environment: beaches, and desert sand dunes. It is composed almost entirely of clean, well-rounded quartz grains and must be dry and in motion to emit sound. Descriptions of the noise range from deafening siren shrieks in the Arabian Desert to barks of a dog on a beach in the Hawaiian Islands. Several theories concerning the origin of the sounds have been advanced. One investigator considered it due to reverberations upon a gliding plane within the dune. After extensive laboratory tests, other writers concluded that the noise was caused by vibration of air films around the particles. Still another suggests that the sounds are due to friction caused by a thin film of salts on the surface of the grains acting similar to resin on a violin bow. After extensive laboratory investigations another postulated that the noise was due to some property of the individual grains, probably their molecular structure.

732. Mirkin, A.I. APPLICATION OF TRIGONOMETRIC LEVELLING IN SANDY DESERT REGIONS Transl. from: Geodez. i kartograf., no.9 pp. 21-24, September 1964 Washington joint pubs. res. serv. JPRS-27260; TT-64-51515; N65-10305; CFSTI

An analysis of the accuracy of the results of trigonometric leveling is discussed; errors of closure of triangles are considered; and the differences in elevation errors, when performed by trigonometric and geometric leveling are investigated.

733. Mosely, F. PLATEAU CALCARETE, CALCRETED GRAVELS, CEMENTED DUNES AND RELATED DEPOSITS OF THE MAALLEGH-BOMBA REGION OF LIBYA Zeitschr. f. geomorph., v.9, no.2 pp. 167-85, 26 ref. DLC G1.Z47

Region consists of a low plateau incised by wadis, and bordered on the coast by cemented and active dune formations, salt marshes and saline lagoons; it is arid (5-10" annual rainfall), with stony shrub desert. In the wadis are strongly-cemented gravels as well as unconsolidated modern gravels; cementation by secondary calcium carbonate is thought to be the outcome of capillarity above the water

table. On the plateau, Miocene limestone is capped by 4-20 feet of calcrete crust, regarded as the B/C zone of carbonate enrichment in a former pedocal from which the A horizon has been lost. On the coast the cemented dunes are cliffed, and pass beneath present sea level; they are longitudinal dunes of Pleistocene age, and show jointing as well as cementation. They are partly overlain by modern, active dunes, mainly shell sand, with features oriented parallel with the NNW prevailing winds. Locally they enclose lagoons (sabakh) or saline flats of black plastic clay, usually bearing Salicornia.

734. Motts, Ward S. HYDROLOGICAL TYPES OF PLAYAS AND CLOSED VALLEYS AND SOME RELATIONS OF HYDROLOGY TO PLAYA GEOLOGY In: U.S. Air Force, Cambridge Research Labs, Geology, mineralogy, and hydrology of U.S. playas Its Environmental res. paper 96 (AFCRL-65-266), pp. 73-104, incl. illus., tables, 1965 DLC TRC: AD 616 243

Playas are situated in closed valleys with a variety of hydrologic patterns. Ground water entering the basin may flow through, around, or under a playa and some, all, or none of it may discharge through the playa surface. Each degree of interchange may produce a distinctive set of surface conditions which have control of development of soils, landforms, and vegetation. Because they appear to be influenced greatly by hydrology, several playa classifications relating composition and amount of ground water discharge are possible. Rate and amount of discharge appear to control directly the solutioning, deflation, and phreatophyte and springmound growth. Falling water tables may produce large-scale desiccation phenomena and contribute to degree aggradation.

735. Mueller, R.D. DESERT TESTS (1954) - TRUCK, CARGO, 4 X 4, M37. U.S. Army, Development and Proving Services, Aberdeen Proving Grounds, MD, Rept. no. 1 and 209, Oct. 25, 1954, 18 pp. DDC AD 77 165

736. Muffler, L.J. Patrick, and Donald E. White ACTIVE METAMORPHISM OF UPPER CENOZOIC SEDIMENTS IN THE SALTON SEA GEOTHERMAL FIELD AND THE SALTON THROUGH, SOUTHEASTERN CALIFORNIA Geol. Soc. Amer. bull., v.80, no.2 pp. 157-81, incl. illus., tables, February 1969 DLC QE1.G2

The Salton Sea geothermal system is entirely within Pliocene and Quaternary sediments of the Colorado River delta at the north end of the Gulf of California. At the time of deposition, these sediments consisted of sands, silts, and clays of uniform original mineralogic composition, but under the elevated temperatures and pressures of the geothermal system they are being transformed to low-grade metamorphic rocks of the greenschist facies. We have studied these transformations by X-ray, petrographic and chemical analyses of cuttings and core from deep wells that penetrate the sedimentary section. Temperatures within the explored geothermal system range up to 360°C at 7100 feet. The wells produce a brine containing over 250,000 ppm dissolved solids, primarily Cl, Na, Ca, K, and Fe, plus a host of minor constituents. The Salton Sea geothermal system displays a continuous transition from sediments through indurated sedimentary rocks to low-grade metamorphic rocks of the greenschist facies. This transition encompasses transformations commonly considered as diagenetic, and takes place without the formation of zeolites.

737. Muffler, L.J. Patrick, and Bruce R. Doe COMPOSITION AND MEAN AGE OF DETRITUS OF THE COLORADO RIVER DELTA IN THE SALTON THROUGH, SOUTHEASTERN CALIFORNIA Jour. sedimentary petrol. v.38, no.2 pp. 384-99, incl. illus., tables, 1968 DLC QE420.J69

The northwest landward extension of the Gulf of California structural depression is filled with fine grained sandstones and siltstones of the Colorado River delta. All are late Cenozoic and average 20,000 feet thick. Provenance is primarily from Mesozoic sedimentary rocks of the upper Colorado drainage basin. Wide ranges in both major and minor elements can be correlated with grain size and clay content of the samples. Lead isotope data from delta samples indicate that the mean age is 1700 m.y., and strontium isotope data indicate the mean age is greater than 500 m.y. In view of the small percentage of exposed Precambrian rocks in the upper Colorado River drainage basin, the bulk of the acid-soluble detritus (as measured and cited above) probably consists of reworked detritus of Precambrian age.

738. Murzaev, E.M. PHYSICAL-GEOGRAPHIC CLASSIFICATION OF ARID RE-

GIONS (Fiziko-geograficheskoe raionirovanie aridnykh oblastei.) Test in Russian Akad. nauk SSSR, Izv., Ser. geogr., No. 4 pp. 16-20, July/August 1957
DLC G23.A35

Both in the U.S.S.R. and abroad the classification of desert and semi-deserts is not yet based upon accepted principles applicable to any gradation from the largest to smallest taxonomic unit. On the continent of Asia the association of mountain with deserts complicates the physical geographic classification of arid lands. The regional division of the mountainous regions of the desert zones of Central Asia, the physical geographic factors forming natural regions in arid zones, and the application of a typological regional classification to arid zones are discussed.

739. Naegele, Antoine VEGETATION OF THE ARID ZONE. THE PROTECTED PARCELS OF ATAR (La vegetation de la zone aride. Les parcelles protegees d'Atar) La Nature (Paris), no. 3286 pp. 72-76, incl. illus., Feb. 1959 DLC Q2.N2

Brief description of the evolution of the Sahara, the disappearance of plant cover and the poor flora due to the combined action of climatic and human factors. An account is given of the experimental results obtained on parcels of terrain in the Sahara (Atar region), which are protected in order to preserve them from human action. After three years of experiment, it can be stated that as soon as plant cover is protected from man and animals, a few months are sufficient for a reasonable increase of its productivity.

740. Neal, James T. PLAYA SURFACE MORPHOLOGY: MISCELLANEOUS INVESTIGATIONS U.S. Air Force Cambridge Research Labs, Environmental Res. Papers no. 283, Rept. AFCRL-68-0133, March 1968, 154 pp. AD 669 130: HC \$3.00; MF \$0.65

Numerous environmental processes affect the development and stability of playa surfaces. Of special significance are hydrologic processes that control the amount and flow of both surface and ground water, and climatic variations which in turn influence the hydrology. This report, in 6 parts, examines some aspects of the playa surface environment.

741. Neal, James T. PLAYA VARIATION In: Arid lands in perspective. Washington, American Assoc. for the Advancement of Science, 1969, pp. 13-44, incl. tables, illus., 80 ref. DLC S613.A7

Playa is the general term used to describe the generally barren depressions, or the lowest portions of desert basins, that periodically collect runoff and sediments; they occur in all of the major arid zones on the earth. There is a wide range in the type, number, and distribution of playas -- from vast floors of formerly permanent lakes situated in large structural basins (U.S. and Chile) to small, wind- and animal-eroded depressions (pans of South Africa). Variation in climate from the existing at present, especially during Pleistocene and post-Pleistocene time, has had profound effects in the development of basin features and in the character of the hydrologic systems found in individual basins.

742. Neal, James T. (ed.) GEOLOGY, MINERALOGY, AND HYDROLOGY OF U.S. PLAYAS U.S. Air Force, Cambridge Research Labs, Environmental research papers, no. 96, AFCRL-65-266, 176 pp., April 1965 DLC TRC: AD 616 243

Playas (dry lake beds), the flat central portions of desert basins, are landforms which have unique properties. Most of those in the United States were sites of larger Pleistocene lakes, and are characterized by fine-grained lacustrine silt and clay, with secondary saline, sulfate, and carbonate minerals. The playa surfaces are essentially level, but hydrologic, tectonic, and climatic forces are continually modifying them. A variety of surface features representing a range of influence of the arid environment have been noted; these features are subject to change in response to a changing environment. Playa basins have been studied in the field using the geophysical methods of gravity, seismology, electrical resistivity, and magnetism. This report is a collection of six individual papers discussing the environment and surface features, mineralogy, hydrology, structure, geophysics and airphoto features of playas.

743. Neal, James T. ENVIRONMENTAL SETTING AND GENERAL SURFACE CHARACTERISTICS OF PLAYAS In: US Air Force. Cambridge Research Labs, The geology, mineralogy, and hydrology of US playas. Its Environmental res. paper 96, AFCRL-65-266, pp. 1-29, incl. illus., tables, maps, graph, April 1965, 18 ref. DLC TRC: AD 616 243

Playas in the western U.S. are found principally in desert basins in the Basin and Range Physiographic Province. Most of the basins were the sites of lakes during the Pleistocene epoch and received large quantities of lacustrine sediment. Thus, many playas are remnants of the ancient lakes, now subject to modification by environmental processes. Playas are highly sensitive to climatologic fluctuations and may periodically alternate from dry to wet surfaces. Playas surfaces in this country may be described as follows: (1) hard, dry, compact crusts; (2) soft, dry, porous, puffy surfaces; (3) soft, sticky-wet surfaces; (4) salt pavements; (5) carbonate surfaces; and (6) mixed surfaces. These surfaces may be correlated with mineralogy and ground-water characteristics. Although playas are remarkably flat and smooth, several processes involving water-table fluctuations are producing giant contraction fissures, phreatophyte mounds, and salt thrust features. May best be characterized as dynamic landforms which are highly sensitive to environmental changes. The changes produce a variety of effects, constantly adjusting to the new environment.

744. Neal, James T. AIRPHOTO CHARACTERISTICS OF PLAYAS In: US Air Force, Cambridge Res. Labs, Environmental res. paper 96, AFCRL-65-266, pp. 149-76, incl. illus., refs., April 1965 DLC TRC: AD 616 243

Playas in the western United States have been studied on aerial photographs, and many of them have been examined in the field. Major types of playa surfaces frequently can be recognized on the basis of albedo, or the amount of light reflection. Geomorphic features that can be observed include sheet wash stains, giant contraction polygons, giant contraction stripes, salt pressure polygons, phreatophytes, hot and cold springs, and surface drainage form. Recognition and understanding of the environmental occurrence of these features enable the prediction of surface properties and ground water characteristics of the basins.

745. Neal, James T. TECTONIC INFLUENCES ON PLAYA MORPHOLOGY
In: U.S. Air Force, Cambridge Research Labs, Environmental res. paper 96, AFCRL-65-266, pp. 105-21, incl. illus., maps, ref., April 1965 DLC TRC: AD 616 243

Playas in western middle North America are located in arid basins that have undergone a complex geologic history, much of which is still unclear. The complexity of the geology does not determine if a playa will exist in a particular basin, for playas are found in much less complicated geologic regions of the world. Rather, it is a combination of topographic, meteorologic, hydrologic, and historical geologic effects that determine their emplacement. Tectonic and structural manifestations in playas are numerous. Specific cases are demonstrated which show effects of faulting, isostatic readjustment, thermal springs, and large-scale contraction in the playa sediments. These features are frequently obscure, but with some certainty it can be predicted that more effects of tectonism will be noted as playas are studied in greater detail.

746. Neal, James T. and Ward S. Motts RECENT GEOMORPHIC CHANGES IN PLAYAS OF WESTERN UNITED STATES Jour. geol., v.75, no.5 pp. 511-25, incl. illus., tables, May 1967
DLC QE1.J8

Features on playas show recognizable changes in response to long and short-term shifts in factors that affect water availability. Giant polygonal cracks, sinkholes, relict spring mounds, and dead phreatophyte mounds have resulted from lowering of the piezometric surface caused by long-term climatic shifts and increase in man's use of water. The same factors cause modifications of the vegetation cover that result in expansion of playas and increased erosion. Short term changes mainly affect small features on playa surfaces.

747. Nikolaev, V.A., and Z.G. Ryabtseva AERIAL PHOTOGRAPHY AS A METHOD FOR THE COMPLEX STUDY OF THE LANDSCAPE OF SEMI-DESERTS AND DRY STEPPES Transl. of: Primenenie aerometodov landshaftnykh issledovaniia, 1961, pp. 105-19. Wash., D.C., U.S. Army Foreign Science & Tech. Center, Prept. FSTC-HT-23-507-68, Sept. 30, 1969, 26 pp.
AD 695 723

Identification of different components of the natural medium (soils, topography, ground waters, etc.) by means of aerial photographs is possible only if there is knowledge of the

intra-landscape relationships of the components. The data used successfully in the Caspian area were not suitable in the Turgay area because the former has accumulative plains while the latter has denudation plains. The whole problem of the study of the structure of landscapes is related with advances in typology and cartography of landscapes.

748. Norris, Robert M. DUNE REDDENING AND TIME Jour. sediment. petrol., v.39, no.1 pp. 7-11, 1969 DLC QE420.J69

Many dune sands become reddened with the passage of time. The process is promoted by warm temperatures, oxidizing conditions, and the periodic presence of moisture. Reddening is due to the gradual weathering of iron oxide and silicate mineral grains; the weathering tends to cause the coatings to become thicker and affects increasing numbers of grains with the passage of time. In addition the hematitic grain coatings are resistant to the abrasion associated with eolian transport. It is suggested that the basic requirements for development of hematitic weathering products -- warm temperatures, oxidizing conditions, and the occasional presence of moisture -- are regularly met in most tropical and sub-tropical dunes, even those in very dry environments, because of the ability of dune sands to absorb and retain rainfall.

749. Norris, Robert M. BARCHAN DUNES OF IMPERIAL VALLEY, CALIFORNIA Jour. geol., v.74, no.3 pp. 292-306, incl. illus., tables, 1966 DLC QE1.J8

Barchan dune origin, shape, movement, volume, and relation to physical and climatic environment were studied at two localities. In the Algodones dune chain, barchans develop in hollows between megabarchans and in about 40 years cross the hollows. West of Salton Sea, detailed surveys show that an isolated, persistently slim and asymmetrical dune decreases its overall rate of advance with increase in volume; it should soon enter and be destroyed in Tule Wash. Similar, genetically related dunes nearer Salton Sea, on a less guillied surface, appear more permanent.

750. Norris, Robert M. and Kenneth S. Norris ALGODONES DUNES OF SOUTHEASTERN CALIFORNIA Geol. soc. Amer., bull., v.72, no.4 pp. 605-19, incl. illus., tables, April 1961, 44 ref. DLC QE1.G2

The Algodones dune belt, which is 40 mi. long in a north-westerly direction, 3-6 mi. wide, and has individual dunes 200-300 feet high, lies along the southeastern border of the Cahuilla basin, a structural depression in southeastern California. Much of the basin is below sea level and includes Imperial and Coachella valleys. The lowest portion of the basin is now occupied by the Salton Sea. Most detritus enters the basin from the high mountains to the W and NW; little material is contributed by the lower, drier desert ranges to the E. The dunes appear unsystematic from the ground, but as seen from the air they consist of long NW-trending ridges on the W which individually curve eastward and disappear in a complex of prominent S-facing slip faces. In the central and southern part of the dune area some of the slip faces are 200-300 feet high and overlook large flat-floored, sandfree depressions which are interpreted as exposed parts of the desert floor over which a succession of large, closely spaced complex barchans is advancing. Present conditions favor destruction of the depressions by encroachment of sand in the form of small linear ridges and barchan dunes from the transverse dunes. Color and degree of rounding of the sand grains indicate that the dunes are now less active than in the past and that the amount of sand is not increasing significantly. The dunes were probably produced by wind transport of sand inshore from the beaches of Lake Cahuilla, a much larger forerunner of the Salton Sea. The large volume of material in these ancient beaches indicates vigorous wave and current action along the northeastern shore of the lake.

751. Neal, James T., Arthur M. Langer and Paul F. Kerr GIANT DESICCATION POLYGONS OF GREAT BASIN PLAYAS Geol. soc. amer. bull., v.79, no.1 pp. 69-90, incl. illus., map, tables, 29 ref., Jan. 1968 DLC QE1.G2

Previous investigators have recognized giant polygonal fissure patterns in 6 playas of the Basin and Range Physiographic Province (Great Basin). This paper extends the study to 39 playas in Oregon, Nevada, California, Arizona, and New Mexico, with observations on the physical and mineralogical features of fissured and nonfissured areas. Fissures are often 5 m deep and the polygons may attain

a width of 300 m. These giant mud cracks develop in clay playas and are attributed to desiccation phenomena. As dehydration proceeds from the surface downward and penetrates the capillary fringe above the water table, shrinkage occurs, which ultimately results in rupture at depth that extends upward to the surface. The mineral constituents of sediments in both the fissured and non fissured areas are predominantly clay minerals, carbonates, salines, and analcite, with fine grains of quartz, feldspar, and ferro-magnesian silicates. Fissured playas possess significantly greater quantities of clay and carbonate minerals as compared to nonfissured playas. The clay minerals, carbonates, and analcite are primarily present in less than 2 m size fraction. This colloidal aggregate is believed to exert a major influence on the physical behavior of the sediments which contain the giant polygons. In particular, the dehydration to an almost dry condition of a clay mass, in which the water content may exceed the mineral content, results in a major loss of volume. The shrinkage leads to rupture with the formation of fissures. The fissures form orthogonal polygons characteristic of volume change in a largely uniform horizontal mass with one surface exposed.

752. Elias, Michael TEMPERATURE CRITERIA FOR DESERT ENVIRONMENTAL TESTING Yuma Proving Ground Materiel Test Directorate, Methodology and Instrumentation Division, March 1972, Tech. Mem. MI-18-72

This technical memo outlines a practical technique to be used as a guideline in evaluating materiel. A degree-hour testing philosophy is discussed, and Yuma's summer degree-hours and the world's extreme degree-hours are developed. Although the degree hour criteria applies to all phases of a materiel's lifetime, it is particularly important in storage (exposure) testing. Appendix C details specific criteria for different storage tests.

753. Ollier, C.D. DESERT GILGAI Nature, v.212, no.5062 pp. 581-583, incl. illus., 1966 DLC Q1.N2

Desert gilgai, as seen at Coober Pedy, an erosion scarp between two flat plains in the stony desert of northern South Australia, are patterned ground features of some origin other than periglacial. Their outline is circular

on the plains and stepped on the scarp slopes; their soil profile features include a gypsite layer at the base -- common to the area -- an increase in the clay fraction towards the surface, and irregular variations in the sand and silt fractions. Desert gilgai seem to have been formed by simple swelling and shrinking caused by variations in moisture conditions.

754. Ohman, Howard L. and Iven Bennett OASIS MODIFICATION OF
DESERT TEMPERATURE AND HUMIDITY Assoc. Amer. geographers,
ann., v.49, no.2 pp. 205, June 1959 (Abstract only)
DLC G3.A7

Desert weather stations frequently are located in oases where plant cover and soil moisture differ sharply from the surrounding desert. Under these conditions, temperatures and humidity may be representative for the oasis area only and have little relation to conditions in the open desert. Measurements made in summer in and around the Yuma, Arizona oasis given an indication of the magnitude of this modification. At standard instrument height, daytime transpiration and evaporation within the oasis depressed air temperature 5 to 10 degrees (F) and elevated dew point as much as 8-12 degrees compared to the nearby desert. At night the oasis effect was even more pronounced. (From a paper presented at the 55th annual meeting of the Association of American Geographers, Pittsburg, Penn., March 30 - April 2, 1959.)

755. Parker, Horace ANZA-BORREGO DESERT GUIDE BOOK: SOUTHERN
CALIFORNIA'S LAST FRONTIER Palm Desert, Calif., Desert
Magazine Press, 1957, 108 pp., incl. illus., map
DLC F868.S15P33

The guidebook provides information on the history, geology, animals, plants, all well illustrated, as well as two fold-out maps, one of the Borrego Valley and one of the Vallecito area. Several trip logs accompany each map.

756. Pashley, Emil F., Jr. SUBSIDENCE CRACKS IN ALLUVIUM NEAR
CASA GRANDE, ARIZONA Ariz. geol. soc. dig., v.4
pp. 95-101, incl. illus., map, 4 ref., Nov. 1961
DLC unbound

Large cracks have appeared in the alluvium of the valleys of southern Arizona at various times but few have been located, described, or studied in detail. New occurrences of these cracks, popularly termed "earth cracks," are being reported continually. The purposes of this paper are: (1) to review the few published accounts of these cracks; (2) to describe earth cracks observed by the writer near Casa Grande, Arizona; and (3) to suggest an explanation for the origin of these cracks by comparison to cracks formed under similar conditions in California.

757. Pashley, E.F., Jr. A REINTERPRETATION OF THE ANTICLINAL
STRUCTURE EXPOSED IN THE NORTHWEST FACE OF PUSCH RIDGE,
SANTA CATALINA MOUNTAINS, ARIZONA Ariz. geol. sol., dig.,
v.6 pp. 49-53, 4 ref., Nov. 1963 DLC unbound

Mapping of the structure of the gneissic rocks of the Rincon, Tanque Verde, and southern Santa Catalina mountains by the author over the past few years has revealed a series of doubly plunging anticlines and synclines whose axes trend approximately N 60°--65° E. The fold exposed in the NW face of Pusch Ridge is similar in shape and trend to these other folds.

758. Paylore, Patricia BIBLIOGRAPHIC SOURCES FOR ARID LANDS RE-
SEARCH In: Arid lands in perspective, ed. by Wm G.
McGinnies and Bram J. Goldman. Washington, Amer. Assoc.
for the Advancement of Science, 1969, pp. 249-75, incl.
index DLC S613.A7

This bibliography is comprised of 370 items, most with annotations. Although derived from the author's previous publications (see nos. 337, 496), it does include many newly discovered and analyzed references.

759. Paylore, Patricia ARID-LANDS RESEARCH INSTITUTIONS: A WORLD DIRECTORY. 1st SUPPLEMENT, 1968. U.S. Army. Natick Labs Earth Sci. Lab, Tech. rept. 69-23 ES, Oct. 1968, 38 pp. AD

This supplement contains information on institutions not included in the 1967 publication Arid-Lands Research Institutions: A World Directory, and furnishes up-to-date information covering changes in data on various institutions represented in the 1967 Directory (see no. 15). Arid-lands research in new institutions in Australia, Chile, Israel, Jordan, Lebanon, Peru, U.S.S.R., and West Pakistan is described. Pertinent documentation information is included under FAO (Italy). Changes cover agencies in Argentina, Australia, Chile, Egypt, England, India, Israel, Jordan, Netherlands, South West Africa, Sudan, U.S., and West Pakistan. A brief list of errata to the 1967 Directory is appended.

760. Peel, R.F. THE LANDSCAPE IN AIRDITY Inst. Brit. geographers, trans., v.38 pp. 1-23, incl. illus., 71 ref., 1966
DLC G7.I6

Reviews various problems of geomorphological interpretation of the earth's arid landscapes. Consideration of the nature and extent of aridity is followed by a brief review of aridity throughout geological time and of the geological criteria of past aridity. Attention is then focussed on the climatic history of the Sahara and it is suggested that some elements in the present-day landscape may date from the Tertiary of even earlier. Geomorphological processes operating in the arid lands are then discussed including the work of water, weathering and wind. The present lack of adequate quantitative data and uncertainties as to the age of features are illustrated by reference to several desert landforms. It is concluded that arid landscapes are both complex and variable so that generalization about them is therefore dangerous.

761. Peel, R.F. SOME ASPECTS OF DESERT GEOMORPHOLOGY Geography,
v.45, no.209 pp. 241-62, 39 ref., Nov. 1960
DLC G73.A15

Particular attention paid to the following: desert weathering, major features of the desert landscape and its evolution; the pediment, desert plains, climatic change, and sand and dunes. Draws attention to the great gaps in knowledge of desert geomorphology, and to the dangers inherent in much of the interpretive theory produced about desert landscapes. Almost every new study underlines the importance of giving full recognition to local and regional differences in past geological history, structure and lithology; and as knowledge grows, it becomes clearer that basic importance must be assigned to reconstruction of the past climatic history before we can finalize about the nature and significance of any hypothetical "arid cycle." Much information points to the conclusion that the greater the aridity, the less actually happens apart from the actions of the wind; and it seems increasingly probable that a great deal of the scenery is essentially relict from earlier periods, some possibly of great antiquity, and quite probably of very different climatic conditions. The great problem for the future would seem to be to assess how much of the scenic evolution can be ascribed to the present desert phase, and until that is established, attempts to produce any definite "cycle" of landscape evolution under aridity by inference from the features of our present deserts would seem both dangerous and premature.

762. Peters, John and Joe sciandrone STABILIZATION OF SAND DUNES
AT VANDENBERG AIR FORCE BASE Amer. soc. civ. engineers,
soil mech. & found. dif., jour., v.90, no. SM4, pt. 1
pp. 97-106, July 1964, 6 ref. DLC TA710.A495

A serious problem was posed by sand movement and deposition affecting the operation of coastal training facilities at Vandenberg Air Force Base. Progressive wind erosion required immediate and effective control measures. After preliminary study and experimentation with available means of erosion control, a combination of four measures was used to fulfill the assignment. These were, in chronological order of the work performed: (1) providing a protective shale blanket in selected areas; (2) imparting cohesiveness to the unstable, noncohesive soil; (3) establishing vegetal cover; and (4) creating a foredune near the shore line as a controlled

deposition zone for drifting sand. Five years of observation have proved the control measure used to be highly effective. The general applicability of the treatment to similar areas is suggested.

763. Petrov, M.P. UTILIZATION OF AERIAL PHOTOGRAPHY FOR THE GEOGRAPHIC STUDY OF THE DESERTS OF CENTRAL ASIA Transl. from: *Primenenie aerometodov landshaftnykh issledovaniia* KH, Moscow/Leningrad, 1961, pp. 120-31. Wash., D.C., U.S. Army Foreign Sci. & Tech. Center, Rept. no. FSTC-HT-23-500-68 Sept. 8, 1969, 19 pp. AD 693 147

Aerial photographic work in the deserts of East Central Asia, in comparison with the deserts in West Central Asia, does not differ basically. The methods of Soviet scientists to utilize aerial photography in the geographic studies on the desert territories of the Soviet Union could successfully be used also in East Central Asia. It is necessary to disseminate widely these methods and achievements in order to introduce these into geographic studies of the tremendous desert territories of the Chinese Peoples Republic.

764. Pewe, Troy L. COLORADO RIVER GUIDEBOOK: LEES FERRY TO PHANTOM RANCH Tempe, Arizona, 1969, 78 pp. (Available from the author, 538 East Fairmont Drive, Tempe, Arizona, 85281. \$2.40 + 15¢ postage.)

A mile-by-mile guidebook with emphasis on the geology. Attention is also paid to the history, prehistory and natural features in general. Topographic maps, geologic cross sections, a glossary and references are also provided.

765. Pianka, Eric R. HABITAT SPECIFICITY, SPECIATION AND SPECIES DENSITY IN AUSTRALIAN DESERT LIZARDS *Ecology*, v.50, no.3 pp. 498-502, incl. tables, graphs, ref., Spring 1969 DLC QH540.E3

From data demonstrating habitat specificity, it is concluded that Australian desert lizards recognize more habitats than North American desert lizards. The large amount of environmental heterogeneity and intimate mixing of habitats in Australia allow many more lizard species to coexist there than in North America. An interpretive hypothesis for lizard speciation by means of habitats fluctuating in time and space is proposed.

766. Picard, Leo OUTLINE OF GROUNDWATER GEOLOGY IN ARID REGIONS
Internatl. geol. cong., 19th Algiers, 1952, compt. rend.,
sect. 8: Hydrogeology of arid and subarid regions,
pp. 117-36, incl. illus., refs. DLC QE1.I6 1952b

Groundwater circulation in Limestone and Dolomite reservoirs in arid regions takes place to a considerable extent in fossil spaces over large subterranean areas and is responsible for many an artesian and sub-artesian well. With proper retainer beds, thickness and structure, limestones have become the foremost suppliers of groundwater. To regional sandstone reservoirs belong, in the main, the artesian water bearing well consolidated sandstone found primarily in continental red-bed series, which are extended over large areas and are usually connected with regional basin-well structures. Following in importance are the unconsolidated and semi-consolidated reservoirs. To this group we attach the prevalent Quaternary-Tertiary clastic sediments which fill up the larger and smaller inland plains or the little deformed coastal plains. They consist of gravel, silt, sand and soft sandstone, are highly permeable and become aquifers through intercalation or lensing with less previous sediments. Too much importance given to alluvial fill as groundwater reservoirs (in arid regions).

767. Plagge, H.J., and L.B. Smith PROJECT RAWIJET: A STUDY OF
WIND VARIABILITY IN SPACE AND TIME AT THE SALTON SEA TEST
BASE Sandia Corp., Res. Rept. SC-3880 (TR), Dec. 10,
1956, 58 pp., incl. illus., 15 ref. DLC DWB (M57.2P698p)

A program of hourly upper wind observations was carried on at 5 stations by the Sandia Corp. and the U.D. Air Weather Service at the Salton Sea Test Base in S California under various synoptic conditions in February-April 1954. On April 5, 1954, balloons were released at 15-min intervals. In one series all units tracked the same balloon. A total of 530 balloon observations reaching 100 mb or 55,000 feet were used in the study. Data are presented in tables and graphs. Previous work is reviewed, instrumentation and methods described in detail, errors due to instruments, to personnel, and to bias analysis. Actual space and time variations in winds at the various altitudes are tabulated to show magnitude of such variations.

768. Plouff, Donald GRAVITY SURVEY NEAR TUCSON, ARIZONA U.S. Geol. Survey, Prof. paper 424-D, pp. 258-59, 1961, 4 ref. DLC QE75.P9

The larger gravity anomalies near Tucson are attributed to the differences in density between alluvium in the valleys, and older rocks, mainly of the Precambrian age, in mountainous areas. Interpretation of the thickness of alluvium is complicated by Tertiary conglomerate of intermediate density.

769. Plouff, Donald GRAVITY OBSERVATIONS AND BOUGUER ANOMALY VALUES NEAR TUCSON, ARIZONA U.S. Geol. sur. repts., Open-file ser., no. 751, 30 pp., incl. tables, 1964

Data is given tabular form for gravity stations near Tucson. The gravity reference base used is Tucson Airport. The following information is given for each station: gravity base value, meter scale value, density, latitude, longitude, elevation, measured and observed gravity, terrain correction, theoretical gravity, free air anomaly, simple and complete Bouguer anomalies.

770. Pond, Alonzo W. THE DESERT WORLD New York, Thomas Nelson & Sons, 1962, 342 pp. DLC GB611.P796

A comprehensive account of the desert world is presented in a narrative style with a minimum of jargon. Details are given on the weather, climate, plants, animals and people of the desert. Includes information on trails, wells, oases, ancient people of the desert, and desert people of various parts of the world. Techniques of survival in the desert are recommended.

771. Porter, William L., and others ANALOGS OF YUMA CLIMATE IN NORTHWEST AFRICA (YUMA ANALOGS, NO. 3) U.S. Quartermaster Res. & Engrng. Center, Environmental Protection Res. Div., Res. Studies Rept. RER-3, March 1955, 25 pp., 21 ref. AD 200 767

The portions of Northwest Africa in which temperatures are analogous to those at Yuma in both winter and summer are

limited to a strip on the interior side of the Atlas Mountains, and a second strip nearly surrounding the Ahaggar Mountains and adjoining the large area of composite analogs in Libya. There remains substantial areas in which temperatures are analogous in summer or winter, but not both although these are less extensive than in Northeast Africa. When areas of analogous mean annual precipitation, occurring as two transverse bands, are superimposed on the map of composite temperature analogy, zones of coincidence are found along the desert piedmont of the Atlas Mountains, including a large section west of the Gulf of Gabes, and farther south of the Air Highlands. The vast, nearly rainless interior of the Sahara is drier than Yuma everywhere except in a few elevated places. Rainfall is quite different from Yuma with respect to seasonality, having a pronounced winter maximum in the north and summer maximum in the south in contrast to the occurrence of both summer and winter maximum at Yuma. Conditions of dew point and cloudiness comparable to those of Yuma in July are found in transverse bands in northwest Africa, bordering the Sahara like those of analogous rainfall. The interior Sahara is less humid and even more sunny than Yuma. Winds in the interior desert are predominantly lighter than at Yuma, although sandstorms are more frequent. Of the elements studied, mean daily temperature range in the warmest month shows the largest area of values comparable to Yuma, covering much of northwest Africa exclusive of the immediate coasts.

772. Post, James Lewis STRENGTH CHARACTERISTICS OF CALICHE SOILS OF THE TUCSON AREA Ariz. Univ., PhD thesis, 1966. Order from: University Microfilms, Ann Arbor, Mich., Order No. 66-15,250, 125 pp., mi \$3.00; ph \$6.00

The physical and chemical composition of caliche soils were investigated in order to determine the compressive strength parameters of indurated and fragmented calcisols. The results of stabilization of fragmented calcisols with portland cement additive were determined. The study consisted of measuring the compressive strength of undisturbed specimens of indurated caliche, determining the composition of the fragmented specimens, and measuring the strength of the remolded calcisols. The effect of admixtures of portland cement on the compressive strength of the remolded calcisols was measured and the soil-cement reaction products

were investigated. The identification of the soil minerals was accomplished by means of x-ray diffraction analysis. The calcisols were found to consist mainly of feldspar and randomly oriented microcrystalline calcite with lesser amounts of quartz and clay minerals. The strength of the calcisols was found to be closely related to its clay content. The strongest indurated calcisols contained very small amounts of clay and the strongest remolded calcisols contained the largest amounts of clay. When the indurated caliche was fragmented it behaved as an inert granular material and with access to water the remolded calcisols were found to lose most of their bearing strength.

773. Pouquet, J. SOME ASPECTS OF THE GEOMORPHOLOGY OF DEATH VALLEY, CALIFORNIA (Quelques aspects geomorphologiques de la Vallee de la Morte, Californie.) Text in French Zeitschrift fur geomorphologie, v.11, no.2 pp. 183-204, incl. illus., 1967 DLC G1.Z47

The lowest point in Death Valley is found in the Devil's Golf Course, a functioning playa with a thickness of over 2000 m of salts and muds, the infilling of various lakes since the Miocene, fed now by the Amorgosa. Other playas in the northern part of the graben receive more silts than salts. One playa is in process of dissection whilst another is buried beneath a field of barchans. There are also deformed and dissected pediments. There are strandlines abandoned by Lake Manly, the last lake of the graben. On the eastern side of the lowest part of the graben, uplifted canyon mouths and fan remnants indicate young faulting of up to 600 m since the Lake Manly phase in the Wisconsin. The distribution of alluvial fans and their degree of coalescence indicate tilting to the west in the north and to the east in the middle; there is a lack of recent movement in the south since the Lake Manly stage. Dunes have accumulated at the contact of the inverse movements of the north and middle where groundwater reaches the surface along the faults and supported vegetation which trapped the sand. In the north three relict sets of fans are inset one within the other; the patina of the gravels of the highest differs markedly from that found on the other two whilst active fan gravels have no patina at all. The highest fan relates to the Lake Manly stage of the late Wisconsin. The chief affluent of the Amorgosa gives good evidence of capture as a result of tectonic movements, explaining its circuitous course.

774. Powers, R.W., L.F. Ramirez, C.D. Redmond and E.L. Elberg, Jr.
GEOLOGY OF THE ARABIAN PENINSULA -- SEDIMENTARY GEOLOGY
OF SAUDIA ARABIA U.S. Geol. Survey, Prof. paper 560-D,
147 pp., 33 ref., 1966 DLC QE79.P9

This stratigraphic description of sedimentary units includes brief accounts of Tertiary and Quaternary deposits. Widely scattered patches of late Tertiary gravels were probably laid down by a group of Tertiary rivers. Several terrace gravels occur, and other features include marine and lake terraces, a basalt lave field, and a calcareous duricrust. Approximately one half of the area is blanketed by aeolian sand, and sand forms are classified into transverse, longitudinal, and "Uring" dunes, and sand mountains.

775. Proctor, Richard J. GEOLOGY OF THE DESERT HOT SPRINGS-UPPER COACHELLA VALLEY AREA, CALIFORNIA, WITH A SELECT BIBLIOGRAPHY OF THE COACHELLA VALLEY, SALTON SEA, AND VICINITY
Calif. Div. Mines & Geology, Spec. rept. 94, 1968, 50 pp.,
incl. illus., tables, map. DLC TN24.C2A33

In Riverside County, where Transverse and Peninsula Ranges meet the Colorado Desert, Precambrian (?) gneisses with various Cretaceous (?) intrusions are termed the Chuckwalla complex; metamorphic spurs of the San Jacinto Mts. are probably late Paleozoic. Seven earlier named Cenozoic formations appear to be only four, with outcrop areas separated up to 10 miles by Recent sediments. Related to the fossiliferous marine Imperial formation, their equivalent conglomeratic and sandy facies are: Coachella-Split Mountain; Painted Hill-Canebrake and interfingering Palm Spring; and Cabezon-Ocotilo formations. Mission Creek fault, in the San Andreas system, shows Recent displacement of 1,100 feet vertically and 800 laterally; local intrusions suggest pre-Quaternary movements. Subparallel in a small Indio Hills area are 12 mappable folds. -- GDC

776. Psuty, N.P., W. Bechwith, and A.K. Craig 1000 SELECTED REFERENCES TO THE GEOGRAPHY, OCEANOGRAPHY, GEOLOGY, ECOLOGY AND ARCHEOLOGY OF COASTAL PERU AND ADJACENT AREAS 3rd rev. ed. Paracas Papers v.1, no.1, 1968, 52 pp.
AD 671 870

A specialized bibliography, limited to 1,000 entries, was assembled as a part of a long-range research program studying marine desert ecology, particularly as it occurs along the central coast of Peru. The ecology of this coast of Peru is more complicated than usual because of the unusual foggy desert environment.

777. Qashu, H.K., and S.W. Boul HYDRAULIC AND MICROMORPHOLOGICAL PROPERTIES OF STREAM CHANNEL SEDIMENTS Water resources res., v.3, no.2 pp. 465-69, 1967 DLC GB651.W32

In arid and semiarid regions of southwestern United States, a large portion of natural water recharge is through channel beds and alluvial deposits in river basins. Water transmission varies with time, location, depth and extent of alluvium, and hydraulic characteristics of flows, sediment loads, and morphology of channels.

778. Quezel. P. ON THE APPLICATION OF PALYNOLOGICAL TECHNIQUES TO A DESERT TERRITORY: PALEOCLIMATOLOGY OF THE RECENT QUATERNARY TO THE SAHARA (De l'application de techniques palynologiques a un territoire desertique: paleoclimatologie du quaternaire recent au Sahara.) In: UNESCO-WMO Symposium on Changes of Climate with Special Reference to the Arid Zones, Rome, 1961, (Provisionsl programme and selected preprints), 9 pp., mimeo., 1961 DWB M77.38 U586cL1

During the last 50 years palynology gained importance in paleonological research. Palynologic studies in the Sahara, consisting of investigations of lacustral sediments, calcareous crust, diatomities and paleosols, proved the existence of fossil pollen. It was established that during the ancient and more recent Pluvials a Mediterranean flora covered the Sahara. During the Neolithic the flora still remained Mediterranean, but slowly yielded to the expanding aridity and finally took its present aspect.

779. Baheja, P.C. ARIDITY AND SALINITY: A SURVEY OF SOILS AND LAND USE In: Salinity and aridity: new approaches to old problems, ed. by Hugo Boyko. Monographiae biologicae, v.16 The Hague, W. Junk, 1966, pp. 43-127, incl. illus., map, table, biblio. DLC QP1.P37

In arid habitats, vegetation is normally in balance with precipitation and the other macro-climatic factors. There is seldom an accumulation of salts in any section of the profile, unless water from the surrounding areas accumulates in depressions or the drainage of the large area is centripetal. When the environment is artificially changed and irrigation is brought to the arid areas, a fluvial environment is established and an agricultural-irrigation

complex develops. The rapid surface evaporation by heat and movement of the soil's moisture up and down the profile profoundly alter the balance of salt in the soil particularly if it contains a considerable part of clay particles. Salt tends to accumulate in certain horizons and steadily appears in the top horizon of the profile, which is the medium from which growing crops draw their water and nutrients. Conditions of waterlogging accentuate the process of salinization. Certain regions have developed from geological materials free from sodium and magnesium elements. But, by and large, most of the arid soils possess these elements derived from the minerals from which such soils have developed. The soils of extreme arid regions are somewhat different from the soils of arid regions. The former are raw mineral soils which have weathered to a small extent, although the physical breakdown is dominant. Three major types are the skeletal soils, the several wind-blown soils and the deposited soils, the latter having received the fine and medium sand blown by wind. In contrast, the arid zone soils are better developed especially the sierozems. Besides these, the desert steppe soils are to be round. The soils of the sierozem group are mature and have a clearly developed profile down to 1.5-2 m.

780. Rahn, Perry H. INSELBERGS AND NICKPOINTS IN SOUTHWESTERN ARIZONA
Zeitschr. geomorphol., new ser., v.10, no.3 pp. 217-25,
incl. illus., table, 1966 DLC G1.Z47

The study of 77 inselbergs in southwestern Arizona supports the hypothesis that the sharp break-in-slope, or nickpoint, between mountains or inselbergs and the adjacent desert plains, originates by passing streams cutting laterally against the mountain spurs. This break in slope is maintained after the streams migrate away, if the bedrock weathers to large-size detritus, but if it weathers to pebble-size or finer debris, this material washes down the slope and covers up the sharp break-in-slope.

781. Raikes, Robert L. FORMATION OF DESERTS OF THE NEAR EAST AND NORTH AFRICA In: Arid lands in perspective, ed. by Wm G. McGinnies and B.J. Goldman. Washington, American Assoc. for the Advancement of Science, 1969, pp. 147-54, incl. 7 ref. DLC S613.A7

The concept of weather fluctuations of relatively short duration is basically more sound in many respects than is

the more widely accepted climate-change explanation as the cause of the formation of deserts. The irreversibility of drought effects in low-rainfall areas is both inevitable and more desert-creative, because of its greater severity, than the generally postulated secular climatic change. Weather-induced ecological change is the fundamental factor in the creation of deserts; it is the ineluctable background against which the abuse of land and its vegetation by man and animals acts only as a possible accelerator. The effect of tectonics is relatively minor and localized. The chronology of deserts is considered only for the period -- the Holocene--approximately datable by the normal archeological methods of relative chronologies fixed at intervals by historical or isotope dating.

782. Ransom, Jay E. ARIZONA GEM TRAILS AND THE COLORADO DESERT OF CALIFORNIA: A FIELD GUIDE FOR THE GEM HUNTER, THE MINERAL COLLECTOR, THE URANIUM HUNTER 1st ed. Portland, Ore., Mineralogist Pub. Co., 1955, 96 pp. DLC TN981.A5R3

Provides much more than a "field guide" for the gem hunter, mineral collector, and uranium hunter. In totality, it essentially treats the history, geography, and geology of the region.

783. Ransome, F.L. ORE DEPOSITS OF THE SIERRITA MOUNTAINS, PIMA COUNTY, ARIZONA U.S. Geol. survey, bull. 725, pt. 1 pp. 407-40, 1922 DLC QE75.B9

A general description of the geology of the Sierrita Mountains area is followed by a discussion of the ore deposits of the Papago and Pima Mining Districts. An outline map of the region is included.

784. Raven, Peter H. NATIVE SHRUBS OF SOUTHERN CALIFORNIA Berkeley, University of California press, 1966, 132 pp. (California natural history guides, no. 15) DLC QK484.C2R3

The shrubs in this guide book are treated in 11 different groups. Descriptions (in some cases, illustrations), habitats, and ranges are given for the spp. in each. A brief bibliography and checklist by family (46 are represented) are appended.

785. Reitan, Clayton H. THE ROLE OF PRECIPITABLE WATER VAPOR IN ARIZONA'S SUMMER RAINS Ariz. Univ. Inst. Atmos. Phys. Tech. repts. on meteorol. & climatol. of arid regions, No. 2 19 pp., incl. graphs, January 31, 1957 DLC QC993.7.T4

The relation between Arizona's summer rains and the amount of water vapor in the air over Arizona was examined. It was found that the occurrence of rain was primarily determined by the moisture content of the air over the state, defined in this study by the amount of precipitable water at Phoenix. The effects of vertical wind shear and stability on the occurrence of rain were examined, but could not be precisely determined and are probably small as compared with the effects of precipitable water. Precipitation efficiency was found to vary directly with variations in the amount of precipitable water, but could be explained by changes in the evaporation of raindrops between cloud bases and ground in environments of differing precipitable water contents.

786. Rempel, P. THE CRESCENTIC DUNES OF THE SALTON SEA AND THEIR RELATION TO THE VEGETATION Ecology, v.17, no.3 pp. 347-58, incl. illus., tables, July 1936, 10 ref. DLC QH540.E3

The crescentic dunes which lie west of the Salton Sea, on a substratum of desert pavement, obtain their sand chiefly from the ancient beach of Lake Cahuilla located to the west and northwest. They are nearly all crescentic but vary greatly as to size and proportion. The prevailing wind is from the west, attaining its greatest velocity in springtime. Wind has a direct influence on the formation of small barchans at the cusps of larger ones, and on certain changes in the proportion of dunes which take place with increase in size. Driven by the prevailing wind, the dunes advance across the plain in an easterly direction, the rapidity of advance depending on the size of the dune and the velocity of wind; the smaller the dune the higher the wind velocity, the more rapid the advance. Plants in the dune field, particularly the woody perennials, often sustain severe injury due to sand blasting. The covering of the vegetation by sand brings about, variously, defoliation, death, or in the case of 2 species, a curious elongation which keeps the foliage crowns of the plants above the sand surface resulting in their survival. Belts of vegetation are formed at the windward edges and sides of the barchans, where thin layers of sand aid in the retention of soil moisture.

787. Richards, Daniel F. PRELIMINARY INVESTIGATION OF DESERT TRANSPORTATION U.S. Army Transportation Environmental Operations Group, Fort Eustis, VA, June 1960, 35 pp., 8 ref. PB 149 222: Order from: LC, mi \$1.00, ph \$6.30

The report contains discussions of desert environment, operation and maintenance of wheeled vehicles, methods of navigation utilized by USATREOG, reconnaissance and night operations.

788. Riise, Erik DESERT TESTS (1954) -- TRUCK, CARGO, 5-TON, 6X6, M54. U.S. Army Development and Proving Services, Aberdeen Proving Grounds, Md., Nov. 1954, 1 vol., Rept. no. 212 AD 59 937

789. Roberts, Don V. and Gary E. Melickian GEOLOGIC AND OTHER NATURAL HAZARDS IN DESERT AREAS In: Seminar on the importance of the earth sciences to the public works and building official. Glendale, Calif., Assoc. Eng. Geologists, Los Angeles Sec., 1966, pp. 315-30, incl. illus.

Various geologic and other environmental conditions affect the safe and economical use of desert regions by exploding population. This paper summarizes problems related to flooding and deposition of alluvial soils, gullying and erosion, collapsing soils, expansive soils, caliche and hardpan, playas and desert lakes, windblown soils, water development, faulting and crustal movements, and damage to agricultural land from accumulation of evaporated chemicals. It is believed that problems in the development of desert regions differ from those usually encountered in more humid regions. In planning desert communities there must be an awareness of the total environment and the impact produced by man on his surroundings.

790. Robison, William G. ANALOGS OF YUMA CLIMATE IN NORTHEAST AFRICA (YUMA ANALOGS, NO. 2) U.S. Quartermaster Res. & Engrng. Cent., Environmental Protection Div., Res. study rept. RER-2, August 1954 (rev. Sept. 1957), 20 pp., 19 ref. DWB AD 200 766

Northeast Africa has considerable areas where the important climatic elements are closely analogous to those at Yuma, Arizona although there are few if any places where these all coincide. Temperatures of the coldest month are analogous over about the northern two-thirds of the

region, reaching the Mediterranean coast in most places. Areas where temperatures of the warmest month are analogous do not lie so far north but extend southward beyond the southern limits of aridity, merging into the perennially hot tropical regions. The highlands of Ennedi and Darfur are too cool to be included. Analogous areas of the other elements plotted -- mean annual precipitation, mean dew point for July, and mean cloudiness for July -- are confined to two transverse bands of varying width, one in the north paralleling the Mediterranean coast and one in the south in the transitional area where desert gives way to tropical steppe. Areas of analogous dew points are also found in a narrow band paralleling the Red Sea coast. The vast interior of Northeast Africa is practically rainless and for this reason is semianalogous to Yuma, where several inches usually fall each year. In the two bands where mean annual precipitation is closely analogous the seasonal distribution is quite different from that of Yuma, as both zones have definite wet and dry seasons and the rainfall is confined to certain months of the year; only on the Red Sea coast near Port Sudan is the rainfall distributed throughout the year as it is at Yuma. The interior of the region is not only more arid than the Yuma desert but also has lower dew points, less cloud throughout the year, and lighter winds most of the time.

791. Robinson, G.M. and D.E. Peterson NOTES ON EARTH FISSURES
IN SOUTHERN ARIZONA U.S. Geol. sur. circ. 466, 7 pp.,
5 ref., 1962

This report describes earth fissures at 6 sites in southern Arizona. These notes are preliminary to a more extensive study and detailed analysis being prepared by hydrologists in the Water Resources Division. Earth fissures were first recorded in Arizona in 1927, and have been noticed with increasing frequency since 1949. Fissures at Black Canyon, Bowie, Chandler Heights, Luke Air Force Base, Picacho, and Sells are discussed and illustrated with photographs.

792. Robinson, T.W. THE ROLE OF PHREATOPHYTES IN THE HIDROLOGY (sic) OF ARID REGIONS Internatl. geol. cong., 20th proc., Sect. 4 pp. 77-92, incl. illus., refs., 1957
DLC QE1.I6 1956b

The vegetation of arid regions may be divided, on the basis of the source of its water supply, into two general classes, xerophytes and phreatophytes. Xerophytes, the more extensive group, are plants that subsist on meager amounts of soil moisture; phreatophytes, which require more water, are plants that habitually obtain their water supply from ground water. In comparison, phreatophytes are more closely related to, and have the greater effect on, the water available for man's use. In addition to their effect on water supply, phreatophytes may grow so densely along streams as to increase the flood hazard by choking the normal overflow channels. The occurrence of phreatophytes may be used as a guide to indicate not only the presence of ground water but also its approximate depth and quality. As these plants use large quantities of water and as most of them are of low economic value, they waste large quantities of ground water through the process of transpiration. This draft on the groundwater reservoirs of the arid regions depletes an already inadequate water supply. Much of this wasted water can be salvaged and therefore conserved by methods that will put it to a higher beneficial use.

793. Robison, William C. and Arthur V. Dodd ANALOGS OF YUMA CLIMATE IN SOUTH CENTRAL ASIA (INDIA -- PAKISTAN -- AFGHANISTAN -- IRAN) (YUMA ANALOGS, NO.4) U.S. Quartermaster Res. & Engrng. Cent., Environmental Protection Res. Div., Res. study rept. RER-4, June 1955, 24 pp., 25 ref.
AD 200 768

Extensive areas of South Central Asia have summer temperatures analogous to those at Yuma. Only in the extremely hot Indus Valley of Pakistan and the interior basins of Iran, and in the perennially cool mountains of Kashmir, Afghanistan, and northern Iran are summer temperature regimes appreciably different from those at Yuma. In winter, however, the area of temperature analogy is restricted by the occurrence of temperatures higher than at Yuma in the southern part of the Indian lowlands, and by the occurrence of lower temperatures in the elevated interior of Iran. Mean annual precipitation falls within some degree of analogy

(i.e., less than 9 in.) over most of the study area. The only areas with higher rainfall are the lowland portion of India subject to monsoon rains, the northwestern part of Iran bordering the Caspian Sea, and some of the higher mountains. The combined areas of analogy and semi-analogy for mean July cloudiness are approximately the same as for mean annual precipitation. Mean July wind speeds are likewise analogous or semianalogous at most of the stations for which values are available, being too high only at some of the coastal stations and in the vicinity of the Seistan Basin near the center of the region. Summer dew points are analogous in a comparatively narrow band between the humid regions that are subject to maritime influences, and the dry highland regions of Kashmir, Afghanistan, and Iran. This analogous band is widest in western Baluchistan and swings northwest near the Persian Gulf coast of the northwest near the Persian Gulf coast of northwestern border of Iran. The greatest coincidence of analogy of combined climatic elements is in western Baluchistan as shown by the records of Panjgur; a similar area of nearly total analogy is found in the Indus River Valley of West Pakistan in the vicinity of Bahawalpur. Results of the study are summarized in a series of maps at the end of the report.

794. Robison, William C. and Arthur V. Dodd ANALOGS OF YUMA CLIMATE IN SOVIET MIDDLE ASIA (YUMA ANALOGS, NO.5) U.S. Quartermaster Res. & Engrng. Cent., Environmental Protection Res. Div., Res. Study rept., RER-5, Sept. 1955 (reprinted May 1958) 18 pp., incl. illus., tables, 17 ref.
AD 200 769

All of Soviet Middle Asia is north of the latitude of Yuma, and most of it is therefore, too cool for temperature analogy with Yuma. In the extreme south, however, two areas have summer temperatures high enough to be analogous. Winters are much colder than at Yuma. Mean annual precipitation is analogous (i.e., 2-6 in.) over a large area extending from the Caspian Sea to the foot of the Tien Shan. Approximately the same area is analogous or semi-analogous (less than 12 mph) at all stations for which data are available except Baku on the Caspian coast, where a mean of 14 mph is recorded. Summer dew points are analogous in the southwestern portion of the study area, including the Aral Sea and Caspian Sea regions. The greatest coincidence of analogy of combined climatic elements is in the extreme southern portion of the study area. Termez on the Afghanistan border is climatically most similar to Yuma; only the occurrence of lower winter temperatures at Termez prevents analogy of all climatic elements investigated. Areas of analogy of pertinent climatic elements are presented in a series of maps at the end of the report.

795. Rosenzweig, Michael L., and Jerald Winakur POPULATION ECOLOGY OF DESERT RODENT COMMUNITIES: HABITATS AND ENVIRONMENTAL COMPLEXITY Ecology, v.50, no.4 pp. 558-72, incl. tables, graphs, ref., 1969 DLC QH540.E3

Investigated the relative densities of granivorous, nocturnal desert rodents in small plots within two arid regions of Arizona to study how sympatric species avoid competitive extinction. The most common rodents were kangaroo rats, *Dipodomys* spp., and pocket mice, *Perognathus* spp. Attempted correlating the density of each species with several environmental measurements, derived from the soil's (1) depth; (2) texture of (3) foliage density. Successful variables derived from plant growth form and foliage density. The soil's resistance to sheer stress also seemed important for a few species. In general, kangaroo rats were associated with sparseness of vegetation; pocket mice with denseness. Bush mice seemed to require bushes and included two *Perognathus* spp., three *Peromyscus* spp., and probably a harvest mouse (*Reithrodontomys fulvescens*). Two other *Perognathus* spp. were taken in grassy habitats. We use variables which correlate with the relative density of various species to construct a model of habitat complexity. The rodent species diversities obtained in our plots can be approximately accounted for by this model. The model is based on the premises that the rodents collectively discriminate four qualities of soil surface, and three heights and two densities of vegetation. In general, specializations based on biotic variables appear most important.

796. Roth, Eldon S. THE SILT-CLAY DUNES AT CLARK DRY LAKE, CALIFORNIA Compass, v.38, no.1 pp. 18-27, Nov. 1960, 6 ref. DLC TN1.C793

Dunes composed of silt and clay-size material are found in many parts of the world. Those found at Clark Dry Lake are considered typical of many silt-clay dunes occurring in the southwestern United States. All of the dunes found at Clark Dry Lake appear to be lee dunes associated with vegetation, and all are smooth and streamlined in shape with no free slip surfaces. Instead the surfaces are much cracked, fairly hard, and composed of the same materials as those found in the surrounding playa. Cross sections

cut through the dunes reveal an interior composed of loose, dry, sand-size aggregate particles and usually one or more former surfaces which appear as consolidated, hardened layers. Mechanical analyses of the dune material and the playa surface material give almost identical cumulative curves, while hand-sieved samples of aggregate particles give similar curves but in the sand size range.

797. Roth, Eldon S. TEMPERATURE AND WATER CONTENT AS FACTORS IN DESERT WEATHERING Jour. geol., v.73, no.3 pp. 454-68, incl. illus., tables, 7 ref., May 1965
DLC QE1.J8

Temperature measurements on the surface and at several internal positions within an outcrop of quartz monzonite on the Mohave Desert (California) were taken over a period of 8 months. Rock temperatures have a maximum range of from 24°-8°C and temperature gradients range from 15°-4°C per foot in the outer 1 foot of rock. Water content of the rock at various points was also determined and was found to increase toward the inside of the rock ranging from 0.05-0.15%. These data and the coefficients of expansion of the constituent minerals indicate that temperature change alone is unimportant in rock disintegration. Water content, on the other hand, is sufficient to serve as an important reagent in chemical rock weathering even in a very dry environment.

798. Ruhe, Robert V. GEOMORPHIC SURFACES AND SURFICIAL DEPOSITS IN SOUTHERN NEW MEXICO New Mexico. State Bur. Mines & Min. Res., Memoir 18, 1967, 66 pp., 60 ref.

Geomorphic surfaces are grouped as alluvial fans, piedmonts, and aprons that adjoin the mountain fronts, basins and scraplet surfaces, and valley-border surfaces that are adjacent to the Rio Grande. Radii of curvature of contours and centres of radii of these land forms have specific geometry. Sediment distribution from source areas is related to the spatial geometry. The geomorphic surfaces range in age from historic time to post late Kansan-Illinoian. The oldest surface is dated relative to a subsurface and its mountain front analogue are multicyclic in origin and are 1100 to 4900 years old. The late Wisconsin

Picacho surface is more than 9550 years old. Distribution rock constituents of the surficial deposits relates to the geometry of land forms and in places is independent of the present drainage net. Clay-mineral assemblages are similar; consequently, cation-exchange capacities of fine-earth fractions are related to amount of clay in the sediment. Surficial deposits commonly are layered and separated by paleosols that are usable stratigraphically in delineating and relating bodies of sediments. On the fans and piedmont, organic carbon and carbonate content and depth to carbonate horizon are related to the orographic-climatic regimen controlled by the rise up the mountain front. In the valley-border surface sequence, increase in redness of the soil B horizon, amount of clay in the thickness of the B horizon, and amount of carbonate in and thickness of the carbonate horizon are related to age of geomorphic surface. Complications are introduced by possible climatic changes of the pluvials and interpluvials. The origin of carbonate horizons (Ca and K horizons or caliche and calcrete is in part pedologic, in part the result of groundwater deposition, and in part the result of surface-water deposition. In low-calcium-content sediments, the source of carbonate is eolian dust that falls on the ground surface, is dissolved and transferred downward and precipitated in a sub-surface zone. Detailed analysis points out the discrepancies that occur and that are to be expected in the radiocarbon dates of the inorganic carbon of the carbonate in caliche.

799. Rula, A.A., W.E. Grabau and R.D. Miles FORECASTING TRAFFIC-ABILITY OF SOILS: AIRPHOTO APPROACH U.S. Army Engineer Waterways Experimental Station, CE, Vicksburg, Miss., Tech memo 3-331, rept. 6, 1963, 218 pp.
DLC TC7.U62, no.3-331, report 7

Part of a comprehensive effort began in 1949, to develop techniques for estimating the trafficability of soil by remote means. Devoted specifically to development of techniques for analyzing and interpreting vertical aerial photographs for soil trafficability purposes. To provide a basis for this study, airphoto and soil trafficability data were collected over a period of several years from 33 humid-climate states and 2 arid-climate states in the United States. This report describes the principles and procedures of airphoto interpretation required to estimate

the trafficability of soils, and summarizes data reported previously in supplemental reports in a form suitable for use by personnel engaged in airphoto-trafficability analyses. Soil factors, slope factors, and obstacle factors, all pertinent to terrain trafficability, are discussed. Terrain is classified into various representative landscapes which are fully described in regard to regional drainage, topography, local erosion, natural vegetation, cultural practices, parent material, soil profile, and trafficability and cross-country movement characteristics. Procedures for airphoto analysis of trafficability are rigidly defined, and an example of photo interpretation is given.

800. Rusnak, Gene A. and Robert L. Fisher STRUCTURAL HISTORY AND EVOLUTION OF GULF OF CALIFORNIA In: Andel, Tjeerd H. van, and George G. Shor, Jr. (eds.), Marine geology of the Gulf of California: a symposium. Tulsa, Okla., Amer. Assoc. of Petroleum Geologists, Memoire 3, 1964, pp. 144-56, incl. illus, graphs, map, 64 ref.
DSC QE39.A5

The geology of the Gulf of California region is discussed as it pertains to developing a hypothetical structural model presented to describe Gulf evolution. The Gulf of California supposedly evolved as fractured plates of crustal material moved northwestward and Pacific-ward by gravitational sliding, on extremely gentle slopes, from the regions of western Mexico uplifted by batholithic intrusions. The source of the uplift and westward tilting, and perhaps the formation of the intrusions, is ascribed to the development of the East Pacific Rise. This rise is the present expression of a subcrustal welt that reaches the North American continent near the south end of the Gulf of California, as demonstrated by the work of Menard and others.

801. Rydstrom, H.O. INTERPRETING LOCAL GEOLOGY FROM RADAR IMAGERY
Geol. Soc. Amer., bull., v.78, no.3 pp. 429-35, March 1967. DLC QE1.G2

Intensity of radar return energy, which is dependent on the manner of radar illumination, surface roughness, and the geometry of the object, is discussed as applicable to

the interpretation of local geology. The principles of radar interpretation of local geology are described and illustrated with radar images and photographs of areas in southwestern United States. The use of radar principles in conjunction with knowledge of geomorphic principles to obtain the maximum of information is also discussed. Applications of radar imagery to military terrain intelligence, natural resource exploration, and planetary exploration are examined.

802. Sale, G.N. NOTE ON SAND DUNE FIXATION IN PALESTINE Empire forest. rev., v.27 pp. 60-61, 1948 DLC SD1.E573

Moving dunes on the sandy coastal strip of Palestine south of Acre, where rainfall is 372-616 mm and winds are strong, are being afforested with Acacia. Seedlings established in the dunes where water is available in wells are planted as soon as practicable into pots filled with a mixture of soil, sand and manure. At 1 year old, the seedlings are planted at the bottom of pits 3 feet deep, which are then filled with sand so that only the top twigs of the plants are to be seen. The original roots are thus in a sand layer which is always cool and moist. To reduce blowing of sand, branches from old plantations are strewn over the area and butts of branches are sometimes buried. Cuttings of tamarisk are planted as wind-breaks. In some areas soil movements are checked within 3 years of planting bushy acacias. A ground cover of grasses, Artemesia and other low shrubs follows and lupines are sometimes sown to enrich the ground cover. A forest soil is developing and the land may be used later for vineyards and other crops.

803. Schmidt-Nielsen, Bodil, and Kurt Schmidt-Nielsen THE WATER ECONOMY OF DESERT ANIMALS Sci. monthly, v.69, no.3 pp. 180-85, incl. illus., 1949 DLC Q11.P3

Some desert animals, as camels, drink water at intervals; others eat succulent plants. The heteromyid rodents, as Perognathus baileyi and Dipodomys spp., of Arizona, live on dry seeds and drink no water. Their skins are without sweat glands, their feces exceptionally dry, their urine scanty and exceptionally concentrated. They spend the day-time in burrows of comparatively high relative humidity, thus diminishing evaporation from their lungs. By such devices, they are able to live with only the water produced by metabolism.

804. Schmidt-Nielsen, Knut HEAT REGULATION IN SMALL AND LARGE
DESERT MAMMALS In: Institute of Biology, the biology
of deserts N.Y., Stechart-Hafner, Inc., 1954, pp. 182-87
DLC GB611.15 1954

The author discusses the mechanism of body heat regulation in the kangaroo rat, the rate of evaporation found under actual desert conditions in mammals of different body sizes, the relation between body size and evaporation rate, the role of surface circulation through fur or clothing in heat regulation and the effectiveness of heat dissipation from the skin surface by means of evaporation of water. Tables giving the evaporation in different animals calculated from the assumption that the water loss necessary to keep the body temperature constant under desert conditions is 0.6kg/m^2 of body surface per hour and evaporation from donkey, dog and man observed under actual desert conditions are included. Graphs showing heat gain from a hot environment in nude and clothed men and the relationship of evaporation in body size and a diagram of the temperature gradients within the surface of an animal are presented.

805. Schoeller, Henri ARID ZONE HYDROLOGY: RECENT DEVELOPMENTS
Paris, UNESCO, Arid Zone Research No. 12, 1959, 125 pp.
DLC GB1003.S32

Chapter I deals with the formation of bodies of ground water, their replenishment and the water resources they represent. Chapter II covers ground water prospecting and development. Chapter III discusses new methods for determining the transmissibility of aquifers. One of the best methods for determining transmissibility is from the non-equilibrium discharge of wells and borings. Chapter IV is a general outline of geochemistry of ground water. It points out changes which occur in stored ground water, in contact with rocks and through climatic factors. Chapter V deals with the use of tracers, particularly radioactive tracers. There is need for tracers with half lives of weeks or months. The importance of microcirculation of water in rocks is emphasized.

806. Schreiber, Joseph F., Jr. INVENTORY OF RESEARCH ON DESERT COASTAL ZONES Chapter III of an inventory of geographical research on desert environments. Arizona University Office of Arid Lands Studies, 1967, 76 pp., 100+ ref. U.S. Army Natick Labs TP 333 AD 664 642

Concerned with those areas of the Earth where major deserts meet the sea. Initially the study was limited to coasts with an arid climate, but was extended to include semiarid coasts where the two climatic types are contiguous along a coast. The following factors were included for consideration: near-shore bottom conditions, tides and currents, surf, breakers, waves, beaches, shore and nearshore erosion and sedimentation, coastal swamps and marshes, and coastal structures and other cultural features.

807. Schumm, S.A. and R. Hadley ARROYAS AND THE SEMIARID CYCLE OF EROSION Amer. jour. sci., v.255, no.3 pp. 161-74, incl. graph, illus., March 1957, 24 ref. DLC Q1.A5

Longitudinal valley profiles, surveyed in small drainage basins in eastern Wyoming and northern New Mexico, indicate that discontinuous gullies are often developed on areas of local steepening of valley fills. The large amounts of runoff lost through channel absorption in ephemeral streams cause increased sediment loads downstream. This promotes aggradation within these valleys and eventual dismemberment of the drainage system by sealing off of tributary channels. Continued aggradation in these valleys steepens the gradient, causing the formation of discontinuous gullies and reintegration of the system by arroyo cutting in the fills.

808. Segerstrom, Kenneth and Hugo Henriquez CAVITIES OR "TAFONI," IN ROCK FACIES OF THE ATACAMA DESERT, CHILE U.S. Geol. sur., prof. paper 501-C, pp. 121-25, incl. illus., 1964, 24 ref. DLC QE75.P9

Cavities that resemble certain niches in rocks of the southwestern U.S. and tafoni of the Mediterranean area are well developed in granitoid rocks and argillite bordering the Atacama Desert along the coast of northern Chile. Similar cavities are developed to a minor degree in granitoid rocks in the Andes. Differential wetting and drying, hydration of feldspar to clay minerals, and removal of waste by wind are believed to be the causal processes.

809. Sellers, William D. DISTRIBUTION OF RELATIVE HUMIDITY AND DEW POINTS IN SOUTHWESTERN UNITED STATES Ariz., Univ., Inst. Atmos. Phys., Scient. rept. No. 13, Feb. 1, 1960 49 pp., 2 ref. DWB

Report consists of three basic parts. In the first, average monthly values of relative humidity are presented for between one and four hours of the day at 126 weather observing stations in the southwestern United States, including all of Arizona, New Mexico, Colorado, Utah, and Nevada, and parts of California, Texas, Idaho, and Wyoming. The nature, accuracy, and importance of these data are discussed briefly. It is shown that the month with lowest average humidities varies systematically from March in central Texas to August in northern Nevada, antedating the westward movement of the Atlantic high pressure system, with its moist unstable air. In the second section, the distribution of dew point over the southwest is discussed. High values are found on the windward sides of most of the larger mountain ranges, near bodies of water, and in heavily irrigated farmland; low values are concentrated at higher elevations and in the dry desert regions bounded by the Sierra Nevada Mountains to the west and the Rocky Mountains to the east. Hourly data for Arizona indicate that the diurnal variation of dew point is small, with a tendency for the lowest values to occur in the midafternoon in dry regions and in the early morning in moist regions, i.e., those with a surface snow cover or with considerable crop irrigation. The final section outlines a method of estimating the mean relative humidity from the mean temperature. Ordinary linear regression techniques are used, with a correction added to account for the systematic geographical distribution of regression errors.

810. Sellers, William D. POTENTIAL EVAPOTRANSPIRATION IN ARID REGIONS Jour. appl. meteorol., v.3, no.1 pp. 98-104, incl. tables, Feb. 1964, 8 ref. DLC QC851.A66

The concept of potential evapotranspiration, as applied to arid regions, is examined using an energy balance approach suggested by BUDYKO. Using data for Yuma, Arizona, it is shown that a 50% increase in the relative humidity of the air above an irrigated field is accompanied by a 10-15% decrease in potential evapotranspiration, a negligible decrease in the net radiation, and a temperature increase of the surface relative to the air of 2 to 3°C. The estimated annual potential evapotranspiration at Yuma is about 2000 mm, which is 30-50% higher than estimates based on Thornthwaite's method.

811. Sellers, William D., and P.S. Dryden AN INVESTIGATION OF HEAT TRANSFER FROM BARE SOIL, FINAL REPORT Ariz. Univ. Inst. Atmos. Phys., 56 pp., 1967

Report of investigations made during summer of 1965. Measurements of the components of the surface energy balance were made at a cleared site near Tucson International Airport to obtain data on heat transfer from bare soil under conditions ranging from stable to very unstable.

812. Sen, A.K. PHOTO-INTERPRETATION TO STUDY ARID ZONE GEOMORPHOLOGY In: International symposium of photo-interpretation 2d, Paris, Sept. 26-30, 1966, papers in group IV.1, "Earth sciences." Rev. inst. franc. petrole, v.21, no. 12 pp. 1903-06, incl. map, 4 ref., Dec. 1966
DLC TP690.A1P322

Systematic aerial photo-interpretation by means of analysing the texture and structure of the images in the arid region of Baloo in Africa has provided clues for photo-interpreting desert landscapes. By means of direct analysis the direct geomorphic units are worked out. A further interpretation indicates the minute details of the dune morphology which explains the occurrence of several wind deposition cycles. Similar topographic features are also noted in the arid zone of India. Photo-interpretation studies preparatory to field work can result in less time needed for field work.

813. Sergeev, E.M. THEORETICAL PRINCIPLES OF ENGINEERING-GEOLOGICAL ESTIMATION OF ARID ZONE ROCKS Internatl. geol. cong., 20th, Mexico, 1956, proc., Sect. 13 pp. 371-97, 1957
DLC QE1.I6 1956b

In the thickness of rocks occurring in the arid zone above the level of ground waters there dominates (according to average annual data) ascending water current through capillaries as compared with descending percolation current. This gives rise to salting of the rock surface horizons, which, in turn, influences their engineering construction properties. Intensity and character of rock salting are determined by their lithological peculiarities, hydrogeological conditions, and physical-geographic features of a given locality. Therefore, a complex of these questions is to be studied during engineering-geological investigations

as well as influence of rock desalting and salting on their physical-mechanical properties. In the arid zone factors of physical weathering prevail over factors of chemical weathering. Therefore, among Quaternary deposits, in a number of cases, there predominate sandy rocks which are the redeposited products of bedrock physical weathering. Sandy and other desintegrated rocks have greater permeability to water, whose study is very important in conditions of arid zone. The value of sandy rocks permeability to water depends on their composition, as well as on structure and texture of the sandy stratum itself. In the arid zone foothill districts torrent flood processes are very much developed and important. The earth flow waters, penetrating into the sand distribution area, when percolating, deposit in them argillaceous and colloid particles which leads to the cementation of sand and to a reduction of its permeability to water.

814. Sergius, Leo A., George R. Ellis and Richard M. Ogden
 THE SANTA ANA WINDS OF SOUTHERN CALIFORNIA Weatherwise,
 v.15, no.3 pp. 102-105, 121, June 1962, 17 ref. Also
 in: U.S. Weather Bur., Weekly weather and crop bull.,
 v.49, no.18 pp. 7-8, April 30, 1962
 DLC QC851.W

The Santa Ana, unless deflected through canyons or by other features of the terrain, comes from a northeasterly quadrant, is dry and usually blows during the fall and winter months. The individual occurrences may last from a day to a week or more. The authors cite various accounts of winds resembling the Santa Ana appearing in literature (Two Years Before The Mast by Richard Dana and Henry Newmark's Sixty Years In Southern California), and in various newspapers in the 19th and present century. Various theories on the origin of the name Santa Ana are presented; the name Santa Ana first appeared in 1880 and antedates by more than 20 years the report of a wind of this type from the town of Santa Ana. The variation of the name to Santana may be a corruption following from the elision of the two adjacent vowels or may be of Indian extration meaning "big wind."

815. Shantz, H.L. HISTORY AND PROBLEMS OF ARID LANDS DEVELOPMENT
In: Gilbert F. White (ed.) The future of arid lands
Wash., D.C., American Assoc. for the Adv. of Sci., 1956
pp. 3-25, 18 ref. DLC GB665.A55

The author discusses the problems of definitions of the arid zone, the climatic characteristics and extent of semi-arid, arid and extremely arid zones and the use of vegetation cover as a measure of aridity; the physiological and morphological adjustments of plants and animals to arid conditions and the ecological means by which they meet drought conditions, namely: drought escape, drought evasion, drought resistance and drought endurance; the use of arid lands by primitive man with particular reference to the Hopi of North America; dry land farming by modern man, especially in the United States; the extension of deserts under human action; and future developments in research and technology for the utilization and control of arid regions.

816. Sharp, Robert P. KELSO DUNES, MOJAVE DESERT, CALIFORNIA
Geol. soc. amer. bull., v.77, no.10 pp. 1045-73, incl.
illus., tables, 1966 DLC QE1.G2

Fifteen years of measurement across individual transverse dunes have established a high degree of activity but only slight net sand movement. Crestal position is not a reliable index of bulk movement. Lee slope beds with 10-25° dip predominate but only modestly reflect prevailing westerly winds. Orographic controls greatly complicate the picture. Smoke pot studies show no strong fixed eddy currents lee of dunes, and strong transverse winds produce little sand movement. Eolian size distribution and sorting characteristics are well established in 10-12 miles of saltation transport with further transport producing further rounding and more mineralogical fractionation.

817. Sharp, Robert P. WIND RIPPLES Jour. geol., v.71, no.5
pp. 617-36, incl. illus., tables, Sept. 1963, 29 ref.
DLC QE1.J8

Two types of wind ripples are distinguished (in the Kelso Dunes of the eastern Mojave Desert, California); sand ripples composed of normal wind-blown sand with a median diameter roughly 0.30-0.35 mm, and granule ripples composed

in part of particles approaching granule size 2-4 mm. The planimetric patterns and facing directions of ripples on dunes indicate antecedent wind conditions and the micro-complexity of wind currents moving over a topographically varied ground surface under a unidirectional wind aloft. Misinterpretation of noncontemporaneous ripples has supported the fallacious concept of a leeside eddy on sand dunes. Granule ripples are much larger than sand ripples, attaining wave lengths up to 10 feet and heights up to 11 inches in the study areas. They form by deflation under strong winds. Surface creep by saltation impact is clearly the transporting mechanism for these larger grains. Owing to a longevity of months or years and heterogeneous internal constitution, including considerable normal wind-blown sand, granule ripples have a prominent internal foreset structure. A mean index of about 15 seems representative for granule ripples compared to roughly 18 for sand ripples, but departures from these means are large. Relationships observed on granule ripples support conclusions drawn from sand ripples to the effect that wind ripples are composed primarily of creeping grains and that grain size exerts great influence on their dimensions and shape.

818. Sharp, Robert P. WIND DRIVEN SAND IN THE COACHELLA VALLEY, CALIFORNIA Geol. Soc. Amer., bull., v.75 pp. 785-804, 1964 DLC QE1.G2

An 11-year study provides data on saltating sand driven across a barren, bouldery alluvial plain by strong unidirectional wind. By weight, 50% of the grains travel within 5 inches, and 90% within 25 inches of the ground. Maximum height attained exceeds 10 feet, even for grains of 304 mm.

819. Sharp, W.E. THE MOVEMENT OF PLAYA SCRAPERS BY THE WIND Jour. geol., v.68, no.5 pp. 567-72, incl. tables, graphs, 8 ref., Sept. 1960 DLC QE1.J8

A theoretical discussion shows that it is possible for the wind to move rocks over a wet playa surface provided a sufficiently high pore pressure exists beneath the rocks. Measurements were carried out to determine the pore pressure which could exist under a rock on a muddy surface. The ratio of pore pressure to total rock pressure gave a range of 0.34 to 0.64, which would correspond to wind velocities of 45 m/sec (100 mph), to 33 m/sec (75 mph) for rocks having a large frontal area to mass ratio of $20 \times 10^{-3} \text{ cm}^2/\text{g}$.

820. Shields, Lora M. and Philip V. Wells EFFECTS OF NUCLEAR TESTING ON DESERT VEGETATION Science, 135(3497) pp. 38-41, incl. illus., 3 ref., January 5, 1962
DLC Q1.S35

Detonation of fission-type nuclear devices results in an inner circle of complete denudation of desert shrub vegetation, often about 0.5 mi in radius, surrounded by a zone of partial and selective destruction which is variable in width. The gross injury to vegetation appears to be attributable to mechanical and thermal effects. Successional change in the composition of the vegetation, due to invasion by plants of pioneer character, is taking place in all disturbed areas.

821. Shreve, Forrest DESERTS OF NORTHWESTERN SONORA Carnegie Inst. Yearbook, No. 23 pp. 138-40, 1924
DLC AS32.A3

Shreve made an expedition from Tucson, Arizona, to Sasabe, then south to Altar, west to Pitiquito, west and south to Libertad, and south to Kino Point. The article is written like a road-log and bears primarily upon the similarity of the low-elevation floras of the Sonoran desert and southern Arizona, with some notes on the ecology of the floras encountered. No maps or photos were included.

822. Shreve, Forrest RAINFALL IN NORTHERN MEXICO Ecology, v.25, no.1 pp. 105-11, January 1944 DLC QH540.E3

This paper describes the amounts, extremes and seasonal distribution of rainfall in Mexico north of the Tropic of Cancer. A small scale map is presented showing the distribution of mean annual rainfall for 1921-1940. Tables are given showing extremes of annual precipitation, length of rainless periods in months, and frequency of longer rainless periods. While altitude and topography have the usual importance in determining the amount of rain, there are great variations resulting from local conditions. In the arid and semiarid regions, an important aspect of the rainfall is its wide variation from year to year, and the duration and frequency of rainless periods.

823. Shreve, Forrest CONDITIONS INDIRECTLY AFFECTING VERTICAL
DISTRIBUTION ON DESERT MOUNTAINS Ecology, v.3, no.4
pp. 269-74, Oct. 1922 DLC QH540.E3

A brief report on an investigation of plant life and conditions as influenced by altitude, with particular reference to the Santa Catalina Mountains near Tucson. The objective was to bring together, on the one hand, data regarding the vertical distribution and upper and lower limits of vegetations and characteristic species, and, on the other hand, to determine altitudinal gradients of some of the physical conditions of greatest importance to organisms.

824. Shreve, Forrest SANDY AREAS OF THE NORTH AMERICAN DESERTS
Assoc. Pacific Coast Geographers Yearbook, v.4 pp. 11-14
incl map, 1935 DLC F851.A79

States the great difference in the amounts of sand in the North American deserts as contrasted with the Libyan, Sahara, and Gobi deserts. He then shows a map of the SW United States and northwestern Mexico that contain large shady areas in their desert regions. In brief form he lists some of the sandy areas in the Mexican desert and notes their character, and which types of plants are found within these areas.

825. Shreve, Forrest PLANT LIFE OF THE SONORAN DESERT Sci.
monthly, v.42 pp. 195-213, incl. illus., maps, 1936
DLC Q11.P3

A report of a lecture delivered at the Carnegie Institution of Washington. He discusses the botany of Sonora and Mexico with especial emphasis on the flora of the desert areas. It is almost an abstract of his much larger work The Vegetation and Flora of the Sonoran Desert which appeared in the Carnegie Inst. Publication #591, and was reissued in 1964 by Stanford University Press (see no. 81).

826. Shreve, Forrest OBSERVATIONS ON THE VEGETATION OF CHIHUAHUA,
MEXICO Madrono, v.5 pp. 1-13, 1939 DLC PRR

The best description of Chihuahuan vegetation up to the time of publication. Divides the region into 5 physiographic units: (1) The Bajada Region; (2) The Enclosed Basin Region; (3) The Elevated Plains Region; (4) The Sierra Madre Region; (5) The Barranca Region. States that the distribution of the types of vegetation run closely parallel to physiographic provinces, and has an excellent vegetation map of this desert. The flora is listed in detail and its relative abundance of certain species is noted. In the physiognomy the types of vegetation resemble those of S.E. Arizona and S.W. New Mexico, except for the strong infusion of endemic or southern species. Besides the map, there are four good photos, and the report has an excellent summary.

827. Simons, F.S. and G.E. Ericksen SOME DESERT FEATURES OF NORTH-
WEST CENTRAL PERU Soc. geol. d. Peru, bol., v.26 pp. 229-46,
incl. illus., tables, graphs, 1953, 5 ref. DLC QE1.S23

Discusses two salient features of the sands of the coastal desert in northwestern Peru. Between Huarmey and Chimbote are various localities of "sand streams," approximately parallel bands of alternating light and dark sands, clearly oriented parallel to the direction of the prevailing winds. The topographic situation and the morphology of these "streams" are described. A preliminary theory about the origin of these bands is presented. The Pur-Pur dune, located SW of the Panamerican Highway between kms 514-515 is described and a calculation of its movement during 10 years is given. Brief resume of the climatic conditions, including data about precipitation and temperature is provided.

828. Milton, D.I. GEOLOGY OF THE ARABIAN PENINSULA -- KUWAIT
Geol. Sur. Prof. paper, 560-F 7 pp., 1967

A review of the surface geology of Kuwait. Kuwait has a desert topography of low to moderate relief. Oil and gas seeps are present at Bahra, bitumen at Burgan and gas at Magua. Relatively little potable water has been discovered within the state, but large volumes of brackish water are available.

829. Simons, Martin DESERTS: THE PROBLEM OF WATER IN ARID LANDS
London, Oxford Univ. Press, 1967 96 pp., incl. illus.,
maps, charts DLC

As the population of the world rises ever more rapidly and the fertile land becomes desperately overcrowded, great efforts will have to be made to conquer the deserts. Discusses what might be done to utilize deserts of the world. After describing desert climates, plants and animals, various sources of water are discussed: water from below ground, from exotic rivers, from other areas, from the sea, from increasing the rainfall, and from changing the climate. The matter of cost of obtaining water is emphasized.

830. Simpson, Eugene S. A GENERAL SUMMARY OF THE STATE OF RESEARCH ON GROUND-WATER HYDROLOGY Chapter VIII of an inventory of geographical research on desert environments Ariz. Univ. Office of Arid Lands Studies, 1967, 18 pp., 50+ ref. (U.S. Army Natick Labs, TP 371) AD 668 853

The history and evaluation of the concepts of ground-water hydrology, and the scope of the field is discussed, followed by a state-of-the-art report on the sources, accessibility and reliability of pertinent information, and the state of ground-water research itself. An extensive bibliography, frequently annotated, is included.

831. Smalley, I.J. and C. Vita-Finzi THE FORMATION OF FINE PARTICLES IN SANDY DESERTS AND THE NATURE OF 'DESERT' LOESS Jour. sediment. petrol., v.38, no.3 pp. 766-74, incl. illus., 1968 DLC QE420.J69

There are no loess deposits within sandy desert areas, but they may occur at the desert margins. The major loess provinces to which a desert origin has been ascribed either are not true loess or are explicable in terms of glacial origin. Desert loess deposits should be distinguishable from glacial loess deposits by their size and their mineralogical nature. Stresses produced by temperature changes can break rocks provided that the rock particles are not below a critical size. Most quartz is introduced into the sedimentary system as sand-size particles (about 500 m); if the critical thermal break size is above 500 m. Then the thermal breakage process will not produce loess-sized particles.

832. Smith, B.R. and S.W. Buol GENESIS AND RELATIVE WEATHERING INTENSITY STUDIES IN THREE SEMIARID SOILS Soil Sci. Soc. Amer. Proc., V.32, no.2 pp. 261-65, incl. tables, 1968
DLC S590.S64A13

Soils selected in the Sonoita Valley, Santa Cruz County, Arizona, from a fan mixture of acid igneous alluvium and limestone fragments, and from alluvial limestone deposits, and in the Avra Valley, Pima County, form a mixed acid igneous alluvial fan. Thin sections of two profiles with argillic horizons and one without revealed only a few clay skins (illuviation cutans) and some stress cutans around edges of gravel particles. Fine clay coarse clay ratios increased in the argillic horizon. Calcium-zirconium ratios, obtained by X-ray, spectrographic analysis of the silt fraction, indicate weathering has been maximum at or near surface, decreasing with depth in all three profiles. It seems that argillic horizons in soils of arid and semiarid regions develop not solely by clay formation in situ, but in combination with enrichment by illuviation of fine clay.

833. Smith, H.T.U. PAST VERSUS PRESENT WIND ACTION IN THE MOJAVE DESERT REGION, CALIFORNIA Mass. Univ. Amherst, Mass., Dept. Geol., Scient. rept. no.1, AFCRL-67-0683, Dec. 1967 39 pp. AD 665 137 HC \$3.00; MF \$0.65

The major products of wind action in the Mojave -- dunes, sand sheets, deflation basins, and deeply abrades rock surfaces -- are interpreted to have been formed during a past arid interval followed by an extended time of relative eolian quiescence. Evidence is presented.

834. Smith, H.T.U. GEOLOGIC AND GEOMORPHIC ASPECTS OF DESERTS In: Desert biology, v.1 by George W. Brown, Jr. (ed.) N.Y., Academic Press, 1968, pp. 51-100, incl. illus., 154 ref. DLC QH88.B7

This broad survey covers the landforms of deserts, including structurally controlled relief and dunes, drainage features and the ground surface. Hydrologic aspects of deserts and their relationship to desert plants and desert soils are then covered. Weathering and other denudational processes are described -- interpretation of these is made difficult by the frequent survival of features from the past. The last section is devoted to climatic change -- the fact that there has been change is well established, but chronologies have not been established for most areas -- an exception is the lakes of the Basin and Range province of the USA. Deserts are particularly sensitive to climatic change.

835. Smith, H.T.U. PHOTO-INTERPRETATION STUDIES OF DESERT BASINS IN NORTHERN AFRICA Mass. Univ. Geology Dept., Contract AF 19(628) 2486, Final report (part 1); March 1963 - July 1968, AFCRL-68-0590, June 1969, 77 pp., plus plates, ref.

Directed toward appraising the feasibility of photogeologic methods for studying characteristics of desert basin floors in the Saharan region, using medium-scale Tri-Metrogon photography. Published information on playas in western U.S. provides some guidance, although the desert basins in Africa have important differences in geologic, topographic, and climatic relationships. The relatively few and widely scattered field observations on particular African basins which are on record provide a further basis for comparison. Generalized data on regional geology and geography contribute also to a frame of reference. Interpretation is based on a combination of direct and indirect types of evidence. The former involves the recognition of specific forms, patterns, markings, and tonal differences seen on photos, and is limited by the scale, type, and quality of the photography. The indirect or circumstantial evidence is based on deduction as to effects of relevant geologic processes working on particular geologic materials under given conditions. Convergence of evidence from all available approaches is sought. Results from interpretation reflect varying degrees of confidence, depending on the degree of detail involved. General features of basins are satisfactorily delineated, but more specific characteristics are dealt with less conclusively; rather than a definitive solution, there is a delimitation of possibilities and an assessment of probabilities. For more particularized interpretation, supplementary data from more adequate photography, from remote-sensing techniques, and from orbital photography or imagery would be most helpful. One conclusion from photogeologic study and survey of the literature is that the dry, firm, flat type of basin floor, well known in the western U.S., is much less common in the Sahara, and has been recognized only in the western part of that region.

836. Smith, Russell GEOLOGY OF THE CERRO COLORADO MOUNTAINS, PIMA COUNTY, ARIZONA Ariz. geol. soc. digest, v.8 pp. 131-45, incl. illus., map, 1966 DLC unbound

The Cerro Colorado Mountains, 45 mi. southwest of Tucson, Arizona, comprise a three-fold sequence of Late Mesozoic (?) to Quaternary lava flows and tuffaceous deposits in a variety

of stratigraphic and structural relationships. Lavas of intermediate to basic composition flowed from local vents over gently arched Cretaceous (?) sedimentary rocks. Water laid tuffs overlie the flows from which they were derived. Pumice, tuff, and rhyolite were then emitted to form a complex sequence with various degrees of welding. Erosion and redeposition filled depressions and mantled marginal slopes with tuffaceous conglomerate. Basalt flows cap the eastern half of the range marking the final igneous activity. At least one local vent is identified for each eruptive cycle. Block faulting led to stripping of basalt followed by gravity sliding of tuffaceous rocks down the northwest flank.

837. Solle, Gerhard RECENT AND FOSSIL DESERTS, AND SOME REMARKS ON RED SANDSTONES (Rezente und fossile Wüste, zugleich Bemerkungen zu Rotsandsteinen.) Text in German. Hessisches Landesamt für Bodenforschung, Notizblatt 94 pp. 54-121, incl. illus., 1966 DLC

A survey of the main types of deserts (hammada, serir, sand desert) and of the most important desert features (salt flats, wadis, desert pavement and varnish, and residual peaks) as studied in north Africa, Arabia, Iran and India. Comparison is made with ancient deposits and landforms which are attributed to desert environments. The principle of uniformitarianism must be applied with certain reservations to pre-Devonian times (when no land plants were present) and to pre-upper Cretaceous times (when no dense vegetation was present in arid and temperate climatic belts). The colour of the deposits of "ancient" deserts is mostly red, whereas deposits of modern deserts are not red. This colouring was derived from the reworking of older, non-desert deposits. A number of geologic formations are definitely known as having been deposited in desert environments. Thus, the lower portion of the Precambrian Torridonian sandstone was formed in a hammada environment and the middle part in serir environment, while the Navajo and Botucatu sandstone was regarded as a desert formation, but this view is now obsolete. Despite this, certain parts of the Bunter, along the edge of the depositional basin, were most likely formed in a desert, or at least, in an extensive dune environment. Some outcrops are thought to represent material filling ancient wadis. The disproportionately small percentage of known desert sediments is attributed to the fact that erosion predominated over deposition in the deserts. Transgression of the sea over the desert surface or climatic changes causing chemical weathering tend to disrupt the distinguishing features of desert sediments.

838. Sorey, Michael L. and William G. Matlock EVAPORATION FROM AN EPHEMERAL STREAMBED Amer. soc. civ. engineers proc., v.95, paper 6368, Jour. hydraul. div., n. HY 1 pp. 423-38, incl. illus., tables, 1969 DLC TC1.A39

(In the southwestern United States, most of the natural recharge to aquifers is from intermittent flow in stream channels in alluvial deposits). Daily evaporation was measured for sands that dry without contact with a water table. Selected sands from an ephemeral stream-bed were packed in cylinders, wetted, and weighed to determine evaporation loss under field climatic conditions. In summer and early fall tests, first-day evaporation from the sands was less than half that from an adjacent Class A Weather Bureau pan. During the first week, evaporation rates for the sands were lower than those reported for irrigated soil. The maximum depth of drying during the three-week tests was less than one foot.

839. Southern California Univ. AN ANNOTATED BIBLIOGRAPHY FOR THE MEXICAN DESERT U.S. Army Engineer Waterways Experimental Station, Vicksburg, Miss. 1958

(not seen)

840. SPECIAL DESERT ISSUE Australian nat. hist., v.15, no.4 pp. 97-131, incl. illus., refs. DLC QH1.A986

The entire issue is devoted to the natural history of the deserts and other arid areas of Australia's interior. Articles of interest include: The desert areas of Australia, by H.O. Fletcher; Landscapes of arid and semi-arid Australia, by J.A. Mabbutt; and, The nature and origin of modern deserts, by R. Sprigg.

841. Stamp, Lawrence Dudley HISTORY OF LAND USE IN ARID REGIONS UNESCO, Arid Zone Res., No. 17, 388 pp., 1961 DLC

The introduction to this compilation covers: causes of arid zones; descriptive discussion of arid areas; plant, animal, and human adjustment to aridity; arid zone hydrology and geology, etc. The compilation itself consists of 15 individual papers on various aspects and areas of aridity. The contributors include Butzer, Shyte, Hamdan, Bharadwaj, etc. Articles range from 6 to 59 pages in length, and several of these have very extensive bibliographies. In English.

842. Stanley, Daniel J. and Donald C. Rhoad DUNE SANDS EXAMINED
BY INFRARED PHOTOGRAPHY Amer. assoc. petrol. geologists
bull., v.51, no.3, pt.1 pp. 424-30, incl. illus., March
1967 DLC TN860.A3

For study of primary sedimentary and biogenic structures in homogeneous coastal dune sands by infrared photography, undisturbed core samples are cemented by saturating with water and freezing. Slices, 4.5 - 7.0 mm-thick, of the core are placed over a light source and photographed with infrared sensitive film. The abundance of sedimentary and biogenic features (burrows, plant remains, and the like) revealed in the samples photographed for this study indicates the coastal dune deposits are far from homogeneous. Structureless, or organically sterile. Such studies can distinguish between humid and arid environments of dune deposition.

843. Stewart, Lincoln A. and A.J. Phfister BARITE DEPOSITS OF
ARIZONA U.S. Bur. Mines, Rept. inv. 5651, 89 pp., 1960
10 ref. DLC TN23.U43 #5651

Describes all occurrences of barite in Arizona that were known or reported to the authors. The history, ownership, production, and geologic setting are discussed for most of the deposits. The uses and specifications of product grades are briefly discussed. Seventy-five deposits were examined in 9 of the 14 counties of the state. The descriptions are given under county headings. In virtually all the deposits the barite mineralization were confined to faults or fracture zones, most in igneous, some in sedimentary, and a few in metamorphic rocks. In about half the occurrences, fluorspar was associated with the barite in quantities varying from a few tenths to as much as 30%.

844. Stophlet, John J. NIGHT LIFE ON THE DESERT Natl. parks
mag., 38(198) pp. 12-15, incl. illus., March 1964
SB482.A466

The Arizona-Sonora Desert Museum, located 15 miles from Tucson, is situated in a 30,000 acre reserve of desert wilderness. In and around the museum buildings live the desert creatures: wild pigs, squirrels, deer, bears, reptiles, birds, and the various members of the cat family. The animal environment duplicates as much as possible their natural desert habitat. A blind overlooking an artificially created pool has enabled the study of the night life of these desert animals, and several observations are noted.

845. Stoyanow, Alexander PALEOZOIC PALEGEOGRAPHY OF ARIZONA Geol. soc. Amer., bull., v.53, no.9 pp. 1255-82, incl illus., tables, map, Sept. 1942, 60 ref. DLC QE1.G2

In Arizona two major areas of deposition separated by Mazatzal Land had already been established by late pre-Cambrian time. The first Paleozoic transgression from the northwest, starting possibly late in the Early Cambrian and depositing the Tapeats sandstone, reached central Arizona. The southern limit of the Bright Angel shale and the overlap of the Muav limestone on the Tapeats indicate subsequent movements northward and southward in early Middle Cambrian time before the final withdrawal of the Cambrian Sea from northern Arizona. In southeastern Arizona, likewise, only the earliest phase of the Cambrian transgression reached the central part of Mazatzal Land; the northwestern boundaries of the late Middle Cambrian Troy, Santa Catalina, Cochise, and the Upper Cambrian Abrigo formation are all successively regressive southeastward. Ordovician strata are known in Arizona only in the areas near New Mexico. Silurian and early Devonian deposits are present only near the extreme peripheral margins of Mazatzal Land beyond the limits of the state. Central-western Arizona was a positive element during the Ordovician, Silurian, and both the Early and Middle Devonian. The overlapping late Devonian transgression, also initiated from the northwest and southeast, deposited clastics around the central part of Mazatzal Land and was succeeded by deeper sea conditions in Mississippian time. The southeastern trough was the deeper of the two basins throughout the Late Paleozoic and is regarded as an arm of the Ouachita seaway. Following the retreat of seas from most of Arizona in the Late Mississippian a marked early Pennsylvanian transgression was introduced from the southeast and limited on the northwest by Mazatzal Land. Grading of the Mazano gypsiferous series and fossiliferous limestones into the Supai northward and distribution of Kaibab faunas establish the relation of the southeastern trough to the northern area of Permian shallow marine and continental deposition.

846. Strain, B.R. SEASONAL ADAPTATIONS IN PHOTOSYNTHESIS AND RESPIRATION IN FOUR DESERT SHRUBS GROWING IN SITU Ecology v.50, no.3 pp. 511-13, incl tables, graphs, refs., Spring 1969 DLC QH540.E3

Field measurements of carbon dioxide exchange and carbohydrate resources show that physiological adaptations occur

in the shrubs Larrea divaricata, Encelia farinosa, Hymenoclea salsola, and Acacia greggii growing in situ in the Colorado Desert of California. L. divaricata, the most widely distributed shrub of the North American deserts, exhibited the greatest seasonal adaptation in the field. This study supports the hypothesis that adaptive temperature acclimations occur in plants.

847. Stretta, Etienne J.P. MAP OF ARID ZONES AS A PRELIMINARY DOCUMENT TO THE STUDY OF UNDERGROUND WATER AND THE ESTABLISHMENT OF HYDROGEOLOGICAL MAPS (La carte des zones arides comme document preliminaire a l'etude des eaux souterraines et l'establissement des cartes hydrogeologiques.) Text in French Internatl. assoc. scient. hydrol., publ. no. 52, pp. 33-39, incl. map, 1960
DLC GB651.J63

The study of groundwater cannot be the same for humid, temperate regions as for semiarid or real desertic zones. On the contrary, in humid regions, the arid zones possess, by themselves, a certain number of geographic characteristics which are not specially favorable for rain water infiltration and storage. As a consequence, an increasing number of more complex and variable techniques must be employed in arid zones for the elaboration of hydrogeologic maps which often requires a previous solution of the existent problems. It deals not only with intake areas but almost always with terrains of transit, leakage points, relays and underground thresholds. Since two-thirds of the emerged land lay on the arid zone, a hydrogeologic map constitutes an important document for any economic development or even the mere problem of survival. On the other hand, there are different degrees of aridity according to climatology and local geographic factors and it seems that any detailed study of geohydrological problems in these regions remains tied to a preliminary task, that of the knowledge of their degrees of aridity. It is according to the degree of aridity that particular problems of rainwater infiltration, evaporation, circulation within non-laminar regimes in rough alluvions or karsts must be studied. Within the frame of this communication, the author presents as an example the maps of arid zones in Turkey (1:1,500,000) and in Mexico (1:3,500,000) elaborated in accordance with Emberger's formula, which seems to be the most adequate base for a geohydrological study.

848. Summers, H.J. TIME-LAPSE PHOTOGRAPHY USED IN THE STUDY OF SAND RIPPLES Coastal res. notes, v.2, no.6 pp. 6-7, 1967 (Florida State Univ. Dept. Geol.)

Observations of subaerial ripples in a dune area of the desert near Palm Springs, California, and of subaqueous ripples at depths of 10-60 feet off Santa Catalina and San Clemente Islands and the photographic equipment used are described. In the desert, a wind vane and wind-speed instrument were added. Underwater a stream of bubbles released from a pressure tank measures water surge velocity and a float records wave regime. Desert ripples either moved straight ahead, reformed over smooth areas, or small ripples reoriented normal to new wind directions; larger ripples became confused. Underwater only oscillation ripples have been observed and only the crests move, with a back and forth motion. In a 44-hr period they moved toward shore one wave length, 12 inches.

849. Sutton, Ann and Myron THE LIFE OF THE DESERT N.Y. McGraw-Hill, 1966, 232 pp., incl. illus., photos, refs.
DLC Q88.S88

Nontechnical volume considers how the plants and animals survive in the forbidding environment of America's deserts. Covers the important differences between the daytime and nocturnal activities of typical desert creatures; the perennial problem of water and the methods animals use to obtain it; other problems of survival, and the differences and similarities among the major desert regions in North America. Appendices contain a comprehensive index and glossary, and special features on endangered species, lizards, and poisonous desert animals.

850. Swift, Charles Moore Jr. A MAGNETOTELLURIC INVESTIGATION OF AN ELECTRICAL CONDUCTIVITY ANOMALY IN THE SOUTHWESTERN UNITED STATES PhD thesis. Mass. Inst. of Tech., Cambridge Geophys. Lab, August 1967, 226 pp.
AD 663 283; mi \$0.65, ph \$3.00

Large scale magnetotelluric observations were made in the southwestern United States by combining telluric data from seven sites with Tucson geomagnetic observatory data. The use of the Tucson data as representative for the telluric recording sites is justified by a quantitative coherency study, which showed that the geomagnetic fluctuations of

fifteen minute to diurnal periods in the southwest are characterized by horizontal wavelengths greater than 10,000 kilometers. The magnetotelluric data is analyzed for tensor apparent resistivities, principal directions, and two-dimensionality measures. The measured anisotropic apparent resistivities are interpreted in terms of inhomogeneous resistivity structure, using theoretical values obtained for two-dimensional models which took the known surface geology into account. The resulting interpretations show a high conductivity zone in the upper mantle of southern Arizona and southwestern New Mexico. Thus, the magnetotelluric evidence supports Schmucker's geomagnetic indication of increased conductivities. Partly because this region is characterized by high heat flow, these high conductivities are attributed to a zone of high temperatures.

851. Sykes, Godfrey RAINFALL INVESTIGATIONS IN ARIZONA AND SONORA BY MEANS OF LONG-PERIOD RAIN GAUGES Geogr. rev., v.21, no.2 pp. 229-33, April 1931 DLC G1.G35

The rainfall of southwestern Arizona, southeastern California and northwestern Sonora is discussed based on studies conducted over a 6 year period. Precipitation varies from an annual average of about 10 inches to less than 2 inches at sea level. Isolated mountain ranges may receive as much as 40 inches upon their *summit* but without affecting the general aridity of the region.

852. Taft, Paul H. STRATOSPHERIC CLOUDS OVER THE SOUTHWEST Amer. meteorol. soc., bull., v.45, no.12 pp. 749-50, December 1964 DLC QC851.A6

Reports that on February 15, 1964 at 1830 MST a narrow bright band of clouds appeared in the twilight arch, and continued to increase in brightness and extent. Five photos taken at 1 minute intervals are shown and discussed. The height of these clouds was calculated by 3 different methods as approximately 31 miles. From the angular extent and distances involved it was apparent that they were distributed over a large portion of southern Arizona and northern Sonora in the Phoenix-Tucson-Nogales-Magdalena area.

853. Thatcher, Leland, Meyer Burin and Glen F. Brown
DATING DESERT GROUND WATER Science, v.134, no.3472
pp. 105-06, July 14, 1961, 3 ref.
DLC QC1.S35

Tritium in Arabian rainfall has followed the trend observed in North America with peaks in 1958 and the Spring of 1959. These measurements will be useful for future hydrologic studies. Water from wadi gravels averages 10 years old; carbon-14 measurements of deep waters indicate ages of several thousand years.

854. Thomas, H.E. THE METEOROLOGICAL PHENOMENON OF DROUGHT IN THE SOUTHWEST U.S. Geol. Sur. Prof. paper 372-A, 42 pp., incl. illus., tables, 52 ref., 1962
DLC QE79.P9

The recent drought is one of several which have been recorded in the arid Southwest in the past century. In regions where precipitation comes chiefly from a single source, as in California and the Great Plains, prevailingly dry periods have alternated with wetter periods, each lasting 10 to 15 years. In the intervening area that includes the basins of the Colorado River and Rio Grande and numerous basins of interior drainage, a deficiency from one source may be ameliorated in some localities by precipitation from another source; in other areas all sources have failed and the drought has continued for a quarter of a century. Earlier droughts of similar duration, and some of longer periods, are indicated by historic records and by studies of tree rings, lake levels and archeologic data.

855. Thomas, H.E. GENERAL SUMMARY OF EFFECTS OF THE DROUGHTS IN THE SOUTHWEST U.S. Geol. Sur. Prof. paper 372-H, pp. H1-H22, 1963 DLC QE75.P9

Final chapter of Prof. Paper 372 summarizes the result of a comprehensive study of drought in the Southwest, as reported in greater detail in chapters A-G. Chapter A presents some of the published and recorded conclusions concerning the basic meteorological factors that influence the patterns of precipitation in the Southwest, and describes the characteristics of the drought of 1942-56 as indicated by meteorologic records. Chapter B is a general discussion of the effects of that drought as shown by hydrologic data. Subsequent chapters (C-G) provide more detailed evaluations

of the effects of drought in individual river basins and specific localities. The effects of drought are discriminated from water shortages due to other cases wherever possible. For this summary, the hydrologic units in the Southwest are classified according to type, and examples of each type are cited. No attempt is made to summarize the effects of drought in every hydrologic unit in the Southwest, as was described in preceding parts of this report. The comprehensive study of drought has required analysis of the longest records available concerning all aspects of the water resources, with special attention to the 1942-56 period to ascertain similarities with earlier drought periods and contrast with periods of greater precipitation. Despite the intended emphasis on drought, the studies have been almost as broad in scope as general studies of interrelations of the hydrologic cycle.

856. Talso, P.J. and R.W. Clarke OBSERVATIONS ON PHYSIOLOGICAL PROBLEMS IN DESERT HEAT: TASK FORCE FURNACE, YUMA, ARIZONA
U.S. Army Med. Res. Lab, Ft Knox, KY, April 1948, 22 pp.
DDC AD 62 767

857. Thomas H.E. and others EFFECTS OF DROUGHT IN BASINS OF INTERIOR DRAINAGE U.S. Geol. Sur. Prof. Paper 372-E, 1963, 50 pp., incl. illus., tables, 44 ref.
DLC QE75.P9

The effects of the recent drought 1942-56 have varied widely in the southwestern basins of interior drainage which include in addition to the Great Basin of Nevada, Utah, and California, many smaller basins in Texas, New Mexico, and Arizona. These closed basins are characteristically separate hydrologic units, and their water resources may logically be developed and regulated independently, which is not true of the subdivisions of the Rio Grande and Colorado River Basins. Several topographically closed basins are independent hydrologic units with respect to surface water but are interconnected by ground water circulation.

858. Thompson, Robert Wayne TIDAL FLAT SEDIMENTATION OF THE COLORADO RIVER DELTA Geol. Soc. Amer. Spec. paper 107, 133 pp., incl. illus., tables, 64 ref., 1968 Price: \$9.50
DLC

Three morphologic or environmental units are distinguished in the coastal mud flats: (1) the high flats, approximating the level of extreme spring tides; (2) the intertidal flats dipping seaward at gradients of 0.1 - 0.2 degree from spring higher-high to spring lower-low tide level; and (3) the subtidal mud flats, extending 11 - 12 m below mean sea level. Deposits of the coastal mud flats cover an area of 2000 km², and are about 16 m thick. Examination of surface sediments in terms of colour, minor structures, texture, and composition of the coarse fraction reveals a zonation of sediment types across the mud flats related to variable exposure to subaerial drying and evaporite crystallization, wave action, tidal currents, and the activity of burrowing organisms. In a seaward direction, i.e., with decreasing elevation, the sequence of sediment types includes: (1) chaotic muds and evaporites, (2) moderate brown, well-laminated clayey silts. Mineralogy, grain size, and the areal distribution indicate that the silts and clay are derived from suspended load of the Colorado River, and are carried to the site of deposition by Gulf tidal currents. Waves truncated the Pleistocene piedmont plain causing rejuvenation and entrenchment of the piedmont washes. Coarse sand supplied thereby is carried northward to form prominent longshore spits which finger out into the intertidal muds. Restriction to tidal flooding imposed by the spits initiated erosion of prominent tidal channels which dissect the southern mud flats. Depositional regression in the southern area has been limited in extent, and has occurred by strand plain development in response to mud-flat encroachment from the north. Sediment supply has been much reduced for the past 50-60 years due to diversion of the Colorado River into the Salton Sea and the subsequent poorly segregated mud-flat deposits, piled coarse mollusk remains into beach ridges fringing the northern high flats, and developed a fine sand and shell veneer over the intertidal zone. Older beach ridges, now largely encased by intertidal muds, record an earlier period of low mud supply and reworking which was probably initiated 1000 to 1500 years B.P. by diversion of the Colorado River into the Salton Basin to the north.

859. Titley, Spencer R. and Carol R. Hicks (eds.)
GEOLOGY OF THE PORPHYRY COPPER DEPOSITS, SOUTHWESTERN
NORTH AMERICA Tucson, Univ. of Arizona Press, 1966,
287 pp., incl. illus., tables, graphs, maps, biblios.
DLC QE79.5.T55

The first part of this book presents eight papers related to areal geology, host rocks, alteration, mineralization, structure and exploration. In the second part, individual deposits, mines and districts are described. Papers relevant to the geology of the Sonoran Desert region are cited separately.

860. Tolchenikov, Yu S. THE ROLE OF SOILS IN THE INTERPRETATION
OF ARID-ZONE LANDSCAPES FROM AERIAL PHOTOGRAPHS Transl.
by U.S. Army Foreign Sci. & Tech. Center, Washington DC,
FSTC-HT-23-492-69, 12 pp., refs.
AD 692 656; CFSTI

The characteristics of soil cover are closely related with all components of the landscape, refracting the specifics of the geologic and geomorphologic structure of the territory, hydrological conditions, migration of chemical compounds, composition of vegetative cover, etc. Examples of interpretation of aerial photographs are given.

861. Tolman, C.F. EROSION AND DEPOSITION IN THE SOUTHERN ARIZONA
BOLSON REGION Jour. geol., v.17, no.2 pp. 136-63,
February - March 1909. DLC QE1.J8

An early and interesting discussion of the "bolson" region of Arizona (i.e., the Sonoran). The topography is described as consisting of (1) an upper rock surface, (2) the bajada, and (3) the playa. An analysis of the geological agents at work under arid conditions, including the effects and importance of torrential precipitation, wind action, and underground water is provided. Discussion also includes the role of climate and a detailed examination of bajada outwash and playa deposits.

862. Tricart, J. and M. Mainguet GRANULOMETRIC CHARACTERISTICS OF SOME EOLIAN SANDS OF THE PERUVIAN DESERT: ASPECTS OF THE DYNAMICS OF BARCHANS (Characteristiques granulométriques des quelques sables éoliens du désert Péruvien; aspects de la dynamique des barchanes.) Rev. géomorph. dynamique, v.15, no.7-9 pp. 110-21, 1965, 15 ref. DLC G1.R443

17 samples of sand from the N Peruvian Desert were analyzed. Moderate supplies of sand are being moved across a hard surface by unidirectional winds. Wind modification of the sand grains is slight. Grains 0.5 to 2.0 mm in diameter migrate slowly by creeping and rolling, forming regular low ripples perpendicular to the wind, and a few cms high, underlain by fine sand. Cumulative frequency curves of log. diameters of grains from the ripples are parabolic (i.e., log. histograms are negatively skewed), indicating forced accumulation of the coarser part of the load as the wind's competence declines. Bimodal distributions result from an admixture of finer sand trapped in eddies. Barchans are composed chiefly of very well sorted fine sand (median 0.16 mm, inter-quartile range 0.05 mm) with sigmoidal (log.-normal) curves indicative of free accumulation of the whole load as it is arrested by the dune. Large dunes move more slowly than small because it takes longer for sand to climb over them. Medium-sized sand tends to move around rather than over dunes, and accumulates in the horns (median grain diameter 0.24 mm). Barchans of coarser sand are subject to selective deflation. Complexities arise where barchans interfere with each other.

863. Tuan, Yi-Fu STRUCTURE, CLIMATE, AND BASIN LANDFORMS IN ARIZONA AND NEW MEXICO Assoc. Amer. Geographers, ann., v.52, no.1 pp. 51-68, incl. illus., tables, March 1962, refs. DLC G3.A7

The Basin Range province of Arizona and New Mexico is characterized by mountain ranges separated by structural troughs. The climate is semiarid to arid. Most of the troughs are filled with thick deposits of alluvium. Many are without external surface drainage. However, 2 large structural valleys, the San Pedro trough in southeastern Arizona and the Rio Grande trough in southeastern Arizona and the Rio Grande trough in central New Mexico, not only

have external drainage but are deeply dissected by the tributaries of their trough-flowing streams. Recent geologic studies and the writer's observations show that the scheme in its simple successive form is not applicable to the lower San Pedro Valley. On the one hand, the irregular arrangement of the basin surfaces, the great range in depth of their dissection, the diversity of their rock materials (granite, semi-consolidated conglomerate, loose alluvium, lake silt), and the occurrence of both erosional and depositional phases seem to argue against it. On the other hand, concrete evidence for structural deformation occurs for the period during which basin land forms were developing. The irregularity and diversity of piedmont surfaces are a difficulty for the cyclic concept, but they can be readily accommodated to the structural interpretation. Thus the deep incision of the upper piedmont surfaces accompanied by deposition lower downslope, the removal of unconformable fan gravels from the upper piedmont, the exhumation of granitic pediments, and the straightness of scarps between upper and lower basin surfaces are some of the features that endorse and enforce the independent structural evidence for the existence of an unstable fundament. Since basin topography evolved largely in the Quaternary period, there is need to consider the influence of climatic change on land forms. Assuming that glacial time was cooler and rainier than postglacial time (following Antevs and Leopold), erosion along the San Pedro River and its main tributaries may be associated with increased and more constant runoff during the pluvial phase. Deposition and valley widening along the same channels are related to post-glacial warming and greater aridity. This association is admittedly tentative.

864. Turnage, W.W. NOCTURNAL SURFACE-SOIL TEMPERATURE, AIR TEMPERATURES, AND GROUND INVERSIONS IN SOUTHERN ARIZONA
Monthly weather rev., v.65, no.5 pp. 189-90, May 1937
DLC QC983.A2

Thermograph traces from the Desert Laboratory, Tucson, Arizona (hillside location) and a site on the Santa Cruz River flood plain, 330 feet below, indicate that in 1936 two-thirds of the nights had a pronounced ground inversion. Average temperature difference on inversion nights between the two elevations was 9°F, maximum 23°F.

865. Turner, A. Keith and Robert D. Miles TERRAIN ANALYSIS BY
COMPUTER Indiana Acad. Sci., proc. 1967, v.77 pp. 256-70,
incl. illus., tables, 1968 DLC Q11.I38

Discusses the development of suitable terrain sampling procedures. Reproducible sampling is an important prerequisite to satisfactory terrain analysis. Terrain variability measures have been developed to differentiate between unique terrain types. The results of these analyses are used to develop stratified samples of compound areas covering entire map sheets. Several computer-oriented terrain analysis methods have been developed and are described in the second part of this paper. Some of these methods are extensions of previously developed or suggested geomorphic techniques in which the computer is used to expedite procedures; other methods are new developments. Examples of computer-prepared contour maps are included. Such maps are useful for rapid study and comparison of different terrain types.

866. Turnage, William V. and Arthur L. Hinckley FREEZING WEATHER
IN RELATION TO PLANT DISTRIBUTION IN THE SONORAN DESERT
Ecol. monogr., v.8, no.4 pp. 529-50, incl. tables, maps,
October 1938 DLC QH540.E28

The coldest waves (1913 and 1937) on record for the region are discussed in relation to injury of native species. Freezing weather at two stations near Tucson is analyzed in detail, with emphasis upon the differences caused by temperature inversions. Inversions are responsible for from 10-20 times as much freezing weather at the basin station as at the hill slope station, but on the 2 coldest nights of a quarter of a century both stations were equally cold. No plants were killed in large numbers, but considerable frost damage in 1937 occurred to numerous species. Few Sonoran Desert species grow in regions where the duration of a freeze exceeds 24 consecutive hours. All grow in areas subject to occasional frosts.

867. U.S. Army. Transportation Board, Fort Eustis, VA
DESERT TEST AND EVALUATION OF TRANSPORTATION EQUIPMENT 1953
Task 9, Final report on Climatic Test and Evaluation of
Transportation Equipment, April 14, 1954, 68 pp.
DDC AD31 987

868. U.S. Army Transportation Board, Fort Eustis, VA
MASS OFF-ROAD TRANSPORTATION TEST OF DESERT CARGO VEHICLES:
SUMMER OF 1953 Interim rept. no. 1, April 19, 1954, 28 pp.
DDC AD 32 224

869. U.S. Army Transportation Environmental Operations Group, Fort
Eustis, VA PRELIMINARY INVESTIGATION OF DESERT OPERATIONS
Daniel F. Richards, Proj. Officer, June 1960, v.1, 38 pp.,
incl. illus., 8 ref. Avail.: CFSTI
DLC UC343.A42 1960

This study of desert transportation is based on the operations of USATREOG Task Element (Desert) at Camp Irwin, California. The report contains discussions of desert environment, operation and maintenance of wheeled vehicles, methods of navigation utilized by USATREOG, reconnaissance, and night operations.

870. U.S. Geological Survey TECTONIC MAP OF NORTH AMERICA
Scale 1:5,000,000, in 2 sheets, each 40 x 65 inches.
Available from the Geological Survey's Distribution Offices
in Washington DC 20242; Denver, Colorado 80225; and Fairbanks, Alaska 99701, at \$5.00/set. An accompanying test,
THE TECTONICS OF NORTH AMERICA: A DISCUSSION TO ACCOMPANY
THE TECTONIC MAP OF NORTH AMERICA, by P.B. King, is issued
separately as: U.S. Geol. Sur. Prof. Paper 628, 1969,
95 pp., \$1.00
DLC QE75.P9

871. U.S. Geological Survey. Water Resources Div., Arizona Dist.
BIBLIOGRAPHY OF U.S. GEOLOGICAL SURVEY WATER-RESOURCES
REPORTS, ARIZONA, 1891-1965. Arizona State Land Dept.
Water Res. Rept. No. 22, 59 pp., incl. tables, 1965

The bibliography is divided into 3 major parts: (1) publications of the U.S. Geological Survey, (2) openfile reports of the Geological Survey, and (3) other publications -- reports prepared by survey personnel, but published by other agencies or by professional organizations in their journals. The bibliography is indexed by area and by subject.

872. U.S. Geological Survey DATA ON WATER WELLS AND SPRINGS IN YUCCA VALLEY - TWENTYNINE PALMS AREA, SAN BERNARDINO AND RIVERSIDE COUNTIES, CALIFORNIA Calif. Dept. Water Res., bull. no. 91-2, June 1960, 163 pp., incl. maps, 8 ref. DLC TD224.C3A53

One of a series for the Mojave Desert region, tabulates all available data on wells and springs in the area from Yucca Valley to Twentynine Palms, 660 sq. mi. between 34° - $34^{\circ}37'N$ and 116° - $116^{\circ}30'W$. It also shows reconnaissance geology, with special reference to the water-yielding deposits. The area is one of interior drainage with no perennial streams. Principal landforms are broad alluvial fans and alluvial plains built out from the eastern slopes of the San Bernardino Mountains and northern slopes of the Little San Bernardino Mountains. Major water-bearing units are alluvial deposits which underlie the fans and fill local structural depressions to varying depths. Movement of ground water is impeded locally by barriers which are presumed to be major faults. These barriers separate the main valley areas into smaller ground water basins. Displacement of ground water is mainly by infiltration of runoff from the mountains. A total of 516 wells and springs were inventoried in the area. Most of these are listed and are located on the map.

873. U.S. Quartermaster Research and Development Center, Natick, Mass. ANALOGS OF YUMA CLIMATE IN THE MIDDLE EAST March 1954, reprinted March 1957, Yuma Analogs no.1, 1 vol. DDC AD134 890

874. United Nations Educational, Scientific and Cultural Organization HUMAN AND ANIMAL ECOLOGY: REVIEWS OF RESEARCH Paris, UNESCO, Arid Zone Research No. 8, 1957, 244 pp., incl. illus., tables, ref. DLC QL751.U55

Articles in French or English, with summaries. The six (6) reports published in this volume (abstracted separately) cover the following aspects of the human and animal ecology of the arid zones: influence of environment in arid regions upon the anatomy, physiology, biochemistry and pathology of human being, including the adaptation of local and immigrant population to this environment.

875. United Nations Educational, Scientific and Cultrual Organization
PLANT-WATER RELATIONSHIPS IN ARID AND SEMI-ARID CONDITIONS:
REVIEWS OF RESEARCH Paris, UNESCO, Arid Zone Research
No. 15, 1960, 225 pp. DLC QK745.U5

Contains nine (9) reviews of research on plant-water relationships in arid and semiarid conditions. Each considers broad problems as well as specific aspects of plant-water relations and traces the concepts as they developed in varying periods of time. A great merit of the volume is the extensive bibliography included with each paper. Each of the reviews is abstracted separately. The contents were made available to the participants in the symposium on plant-water relationships, organized jointly by UNESCO and the Spanish authorities and held in Madrid in September 1959.

876. United Nations Educational, Scientific and Cultural Organization
ENVIRONMENTAL PHYSIOLOGY AND PSYCHOLOGY IN ARID CONDITIONS:
REVIEWS OF RESEARCH Paris, UNESCO, Arid Zone Research
No. 22, 1963, 345 pp. DLC QP82.U46

The papers presented in this volume were delivered at the Symposium on Environmental Physiology and Psychology in Arid Conditions, Lucknow, December 1962. Contents: Lee, Douglas H.K., Physiology and the arid zone, p. 15-36. Schreider, Eugene, Physiological anthropology and climatic variations, p. 37-73. Mayer, Jean, Nutrition and nutritional diseases in the arid zone, p. 75-87. Kenney, Richard A., Principles of renal function with reference to the role of the kidney in salt and water metabolism in the arid and semi-arid zones, p. 89-129. Galser, E.M., Circulatory adjustments in the arid zone, p. 131-51. MacFarlane, W.V., Endocrine functions in hot environments, p. 153-222. Fuhrman, Frederick A., Modification of the action of drugs by heat, p. 223-37. Lambert, G.E., Work, sleep, comfort, p. 239-72. Sargent, Frederick, II, Tropical neurasthenia: giant or windmill, p. 273-314. Henschel, Austin and McPhilimy, Harry S., Field test methods, p. 315-345.

877. United Nations Educational, Scientific and Cultrual Organization
CLIMATOLOGY AND MICROCLIMATOLOGY: PROCEEDINGS OF THE CANBERRA
SYMPOSIUM, October 1956. Paris UNESCO, Arid Zone Research
No. 11, 1958, 355 pp. DLC QC993.7.U52

Contains the papers of the Australian and foreign scientists invited by the UNESCO to the International Symposium at Canberra on the climatology, and particularly the micro-climatology, of arid zones. Eight sessions were held and about 50 papers presented. The subjects treated at the different sessions were: evaporation and the water balance (9 papers); radiation and the thermal balance (7 papers); interrelationships of climatic elements and fauna (3 papers); microclimate of man and domestic animals (4 papers); modifications of microclimate (5 papers); salting and chemistry of rainwater (2 papers); climatological observational requirements in arid zones (7 papers). In general, each paper is accompanied by a summary and bibliography. Each section is followed by a summary of the discussions and conclusions. The work contains an index of the authors quoted and of the subjects. It constitutes a synthesis work and brings an important contribution not only to the climatology and micro-climatology of the arid zone, but also to the climatology and microclimatology in a general sense.

878. United Nations Educational, Scientific and Cultural Organization
PLANT ECOLOGY: REVIEWS OF RESEARCH UNESCO, Arid Zone
Res., No. 6, 377 pp., 1955 DLC

The reports in this volume are reviews of the literature and research on the plant ecology of arid and semiarid regions. Special attention is given to wild species of plants that grow in arid regions and that might be suitable as agricultural crops. As is to be expected, all the contributions are concerned in one way or another with various aspects of the relationships between plants and climate.

879. United Nations Educational, Scientific and Cultural Organization
REVIEWS OF RESEARCH ON ARID ZONE HYDROLOGY Paris, UNESCO,
Arid Aone Program 1, 1953, 212 pp., 1622 ref. \$4.50
DLC GB665.U5

Important document resulting from International Scientific Cooperation. With the exception of the deserts under Soviet control, there is a review for each arid region, as Northwest Africa (new rainfall map), Northeast Africa, Union of South Africa and Angola, Middle East (excellent data), India and

Pakistan, United States and Canada (a very substantial review), Latin America and Australia. Maps of the world distribution of arid and semiarid homoclimates (by P. Meigs) are added. Other maps show the distribution of rainfall, temperature and hydrologic basins for selected regions.

880. United Nations Educational, Scientific and Cultural Organization
-- World Meteorological Organization
SYMPOSIUM ON CHANGES OF CLIMATE WITH SPECIAL REFERENCE TO
ARID ZONES, ROME, 1961, PROCEEDINGS Paris, UNESCO, Arid
Zone Research No. 20, 1963, 488 pp.
DLC QC981.S9 1961

A collection of 45 papers describing original research and ideas on climatic changes. Grouped into four sections designated as: changes during the period of meteorological records; changes during the late geological and early historical records; theories of changes of climate; and significance of changes of climate. The final paper sums up conclusions to be drawn from these contributions.

881. Van Bavel, C.H.M. and L.J. Fritschen ENERGY BALANCE OF BARE
SURFACES IN AN ARID CLIMATE UNESCO, Arid Zone Res., No. 25
pp. 99-107, 1965 DLC

Description of proceedings for using the net radiometer, the thermotransducer (for measuring heat flow in the soil), the weighing lysimeter for measuring heat flux, and the direct contact anemometer for determining sensible heat flux is given. The results of measurement of energy balance of wet surface and of a relatively dry surface are presented.

882. Van Bavel, C.H.M., L.J. Fritschen, and R.J. Reginato
SURFACE-ENERGY BALANCE/IN ARID LANDS AGRICULTURE, 1960-61
U.S. Agricultural Res. Sur., Production Res. Rept. no. 76,
December 1963, 46 pp., incl. illus., tables, 7 ref.
DLC DNAL

Instrumentation and an appropriate experimental site have been completed and 4 experiments carried out (1960-61) at

the U.S. Water Conservation Lab in Salt River Valley, Arizona for a detailed study of the surface energy balance in an arid climate. Features of the installation are described: a precision weighing lysimeter system, net radiometry on

automatic data handling system with a total capacity of 46 channels, including lysimeter weight, windspeed and direction, heat flux, radiation, temperature, and humidity. Preliminary, gross analysis indicated that when the entire observation area is uniformly treated, the evaporative flux from a shallow layer of water and from a wet, bare soil surface show little difference despite greater net radiative flux over the shallow layer of water. In neither case was heat extracted from the air on a daily basis, but the opposite took place, particularly over shallow water. Over an isolated ponded surface considerable downward flux of sensible heat was found over a 24-hour period and also over an isolated wet surface. The progressive drying of the soil surface affects the energy balance profoundly by increasing the albedo and surface temperature, and by decreasing the transport of soil moisture to the surface. Consequently, net radiation decreased, evaporation decreased, and heat flux from the surface into the air increased. No great influence on soil heat flux was found. Evaporative flux was not regular, particularly during the middle and latter part of the day. Sensible heat flux into the air varied in sign and magnitude, seemingly dependent upon surface conditions and wind character.

883. Van Lopik, J.R., and J.R. Compton CLASSIFICATION OF TERRAIN FOR MOBILITY PURPOSES U.S. Army Engineer Waterways Expt. Sta., Vicksburg, Miss., Rept. no. misc. paper 4-444, Aug. 1961, 25 pp. AD 666 222

The principal elements of landscape that affect the capability of vehicles to travel cross country are topography, surface composition and consistency, vegetative cover, and hydrography. These elements combined in various ways tend to deny and slow movement, decrease efficiency, increase maintenance, increase driver fatigue, and control direction. This paper presents a few techniques which have been developed to classify and map terrain elements in objective and fairly quantitative terms. Techniques of this type may eventually permit valid evaluations of trafficability and mobility characteristics of specific areas.

884. Van Lopik, J.R. and C.R. Kolb HANDBOOK: A TECHNIQUE FOR PREPARING DESERT TERRAIN ANALOGS U.S. Army Engineer Waterways Experimental Station, Vicksburg, Miss., Tech. rept. 3-506, May 1959, 184 pp., 23 ref.
AD 217 639; PB 146 038 Order from: LC, mi \$8.40; ph \$28.80

A technique is described whereby desert areas selected for terrain comparison are mapped in terms of general terrain factors, geometry factors, ground factors, and vegetation. Terrain-factor data are synthesized to establish varying degrees of analogy of particular desert areas with portions of any selected base area. This synthesis includes compilation of their component terrain-factor maps. A composite analog map is prepared by superimposing geometry, ground, and vegetation analog maps and stratifying the resulting combinations. Highly analogous desert tracts exhibit, or closely approximate, combinations of terrain-factor mapping units found in the base area, and the degree of analogy decreases directly as the similarity to such combinations decreases. Small areas mapped at large scales can be compared with areally similar tracts or with larger regions mapped at smaller scales.

885. Van Lopik, J.R., Charles R. Kolb and John H. Shanburger ANALOGS OF YUMA DESERT TERRAIN IN THE NORTHWEST AFRICAN DESERT, 2 Vols. U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss., Tech. repts., 6; 3-630-Vol. 1; 3-630-Vol. 2, June 1965, 53 and 26 pp.
AD 466 206; AD 466 207

886. Van Wijk, W.R. and J. De Wilde MICROCLIMATE UNESCO, Arid Zone Res., No. 18 pp. 83-113, incl. ref., 1962
DLC GB611.P3

This article presents a survey of the present state and perspectives of knowledge of microclimate (including micro-weather) in arid zones. Information is then given on energy balance, evapotranspiration, soil temperature, shelter belts, windbreaks, dew, fog, relation to insects and pathogens, on the use of microclimatological data in applied entomology and plant pathology.

887. Veyisov, S. THE MECHANICS OF THE FORMATION OF BARCHAN CHAINS, FROM EXPERIMENTAL MATERIAL (O mechanizme formirovaniya barchannykh cepej po eksperimental'ny'm.) Text in Russian Akad. nauk SSSR, Izv. Ser. geogr. no.3 pp. 66-70, 1966 DLC G23.A35

Barchan chains are a more complex form of eolian desert relief than individual barchans. Contrary to the view of some authors, barchan chains are found to be formed as a result of the joining of individual barchans. Also contrary to the view of some authors, seasonal shift of prevailing winds from opposite directions is required for the formation of such a chain. Barchan chains may form with a single prevailing wind.

888. Vinogradov, B.V. GEOGRAPHIC CORRELATIONS IN DISTANT EXTRAPOLATION OF INTERPRETATION CHARACTERISTICS OF LANDSCAPE ANALOGS Transl. of: Primenenie aerometodov dlya izuchenia gruntovykh vod., 1962 pp. 114-43, Washington D.C., U.S. Army Foreign Sci. & Tech. Cent., Rept. FSTC-HT-23-740-68, Nov. 4, 1969 58 pp. AD 696 915

Distant extrapolation of interpretation characteristics is determined primarily by geographic correlations and is conducted along basic geographic zones and within the limits of zone it is conducted by landscape analogs. Interpretation characteristics developed on key sections can be extrapolated for landscape analogs. Interpretation characteristics developed on key sections can be extrapolated for landscape analogs in the USSR and foreign countries.

889. Vinogradov, B.V. EXPERIENCE IN LARGE-SCALE LANDSCAPE INTERPRETATION AND MAPPING OF KEY SECTORS IN THE ARID AND SUBARID ZONES OF CENTRAL ASIA AND KAZAKHSTAN Transl. of unidentified Russian document. Washington DC, U.S. Army Foreign Sci. & Tech. Center Rept. FSTC-HT-23-505-68, August 8, 1968 36 pp. AD 692 374

A presentation of some results in an experiment with large-scale landscape mapping based on the interpretation of aerial photographs taken during geological, soils and hydrogeological studies in western Turkmenia and in Northern and Western Kazakhstan in 1952-1958. Although the recommendations in this paper on landscape mapping are to a considerable extent local, they can be useful for comparison with results in other geographic areas when solving other problems. The author deals with all the basic problems

involved in landscape mapping, such as scales and accuracy. In the text a number of aerial photographs are accompanied by landscape maps compiled on the basis of these photographs. These landscape maps in turn are fully analyzed in the text as examples of the application and problems of landscape mapping. The author demonstrates the complexity in interpreting aerial photographs because of the spatial and functional correlations among the individual elements, such as geology, soils, vegetation and hydrogeology. The methods used in compiling such methods are described and the possible applications of such maps in the national economy are discussed.

890. Vivo, Jorge Abilio GEOGRAPHY OF MEXICO (Geografia de Mexico)
4th ed. corrected and enl. Mexico, D.F., Fondo de Cultura
Economica, 1958, 349 pp., incl. illus., charts, graphs,
tables DLC F1215.V8

An excellent summary of the geography of Mexico (in Spanish) which should prove to be of value. Included are chapters on the configuration, limits, and extensions of the national territory of Mexico, the geologic formations, the structure, the volcanic and desert regions, the climate and climatic types, the rivers and lakes, the flora, and the agricultural regions. The section on vegetation and cultivated areas, especially as related to Chihuahua is of particular interest and value.

891. Vivo Escoto, Jorge A. THE PHYSIOGRAPHY OF MEXICO AND THE PROBLEMS OF ITS NOMENCLATURE (La fisiografia de Mexico y los problemas de su nomenclatura.) Text in Spanish. Union Geogr. Internac. Conf. Latinoamericana Mexico, proc., 1965 Mexico D.F., Soc. Mex. Geogr. Estadística, v.3 pp. 200-08, incl. table, 1966 DLC

The evolution of physiographic nomenclature in Mexico, from colonial times to the present, is reviewed briefly. A table, from the 4th Congreso Nacional de Geografia, summarizes names used by various authors for the major regional features of Mexico.

892. Vogl, Richard J. and Lawrence T. McHargue VEGETATION OF
THE CALIFORNIA FAN PALM OASES ON THE SAN ANDREAS FAULT
Ecology, v.47, no.4 pp. 532-40, incl. illus., ref.,
Summer 1966 DLC QH540.E3

The vegetation of 24 oases located in the western Colorado Desert was composed of 78 species from 34 families, with an average of 11 species per oasis. Species distributions within an oasis were determined by available water. The three belts include the hydric zone, the oasis-proper zone and the desert-oasis ecotone. Oases were located on hill-side seeps or in canyon washes.

893. Vostokova, E.A. APPLICATION OF THE GEOBOTANICAL METHOD IN
HYDROGEOLOGIC STUDIES OF DESERTS AND SEMIARID REGIONS
Transl. by Gaida M. Hughes. Internatl. geol. rev., v.3,
no.6 pp. 485-94, incl. illus., tables, June 1961, 8 ref.
DLC QE1.I7

Plant associations in arid and semiarid regions serve as indicators not only of presence of ground water, but of its depth, relative salinity, and seasonal variations. Plants such as phreatophytes may serve as direct water indicators, while Anabasis salsa, an indirect water indicator, is more indicative of geologic conditions, in this case clayey or argillaceous soils. An Anabasis salsa association in the Temirsk-Artyubinska Ural region indicates that the ground water is located at considerable depth; in the northwestern Caspian area, however, this same association is often found in low wastelands forming localized impermeable horizons where ground water may be found at depths of 5 to 10 m. Some associations indicate the degree of salinity, rather than ground water depth. Preparation of a ground-water resources map from such geobotanical data requires field work, during which associations around known wells, ponds, or ground water areas are analyzed to provide criteria for the area as a whole. It has been found that data from field studies tally closely with that made from aerial photographs. Hence, after initial studies are made, prospecting of a given region may be carried out by aerial photographs. Variations in vegetation relative to depth and mineralization of ground water also may be used to forecast changes in the vegetation which would occur following construction of an irrigation system.

894. Wadsworth, William B. THE CORNELIA PLUTON, AJO, ARIZONA
Econ. geol., v.63, no.2 pp. 101-15, incl. illus., table,
1968 DLC QE1.E15

Extreme tilting and faulting of the Cornelia pluton has exposed rocks that once lay far below the mineralized apex, as has been pointed out by Gilluly (1946). Petrographic study of specimens from 65 localities in the deeper zone, spaced 0.25 mi apart in a grid, has identified a sequence of temporally discrete intrusive episodes. Lithologic varieties are, from oldest to youngest; quartz diorite, granodiorite, equigranular quartz monzonite, porphyritic quartz monzonite, and porphyritic microquartz monzonite. The shape of the last-named centrally situated body is similar to that of the New Cornelia ore body, and the unit is lithologically correlative with those that predominate in the mine area, suggesting that it represents the conduit.

895. Walker, Theodore R. FORMATION OF RED BEDS IN MODERN AND ANCIENT DESERTS Geol. soc. amer. bull., v.78, no.3 pp. 353-68, incl. illus., table, March 1968. DISCUSSION by Robert F. Schmalz, and REPLY by T.R. Walker. IBID, v. 79, no.2 pp. 277-82, February 1968
DLC QE1.G2

From a study of Recent, Pleistocene, and Pliocene red beds deposited in fluvial and fluvial-marine transitional environments in the Sonoran Desert of northeastern Baja California, it is concluded that red beds were formed after deposition in hot arid or semiarid climates. They are associated with evaporites in an area where faunal, floral and pedological evidence indicates a low rainfall. Both red conglomerates and red intertidal muds show that alteration of hornblende and biotite produced red hematite stained beds. The late Paleozoic red beds of Colorado are interpreted as analogs.

896. Walker, T.R. and R.M. Honea IRON CONTENT OF MODERN DEPOSITS
IN THE SONORAN DESERT: A CONTRIBUTION TO THE ORIGIN OF
RED BEDS Geol. soc. Amer. Bull., v.80, no.3 pp. 535-44,
March 1969 DLC QE1.G2

Surface weathering on the Sonoran Desert produces iron-bearing clay minerals which are concentrated in fine-grained sediments eroded from the desert. The clay fraction of the desert soils and desert-derived alluvium contains an average of about 4.5% total iron. An average of less than 1.0% iron occurs in oxide coatings on grains; the remainder is held in the clay-mineral lattices. It is inferred that under favorable interstitial chemical conditions the iron oxide coatings age to hematite and the clay undergoes postdepositional alteration, yielding additional iron which ultimately forms additional hematite pigment. Biotite, another important source of iron, commonly is associated with the clay and undergoes similar intrastratal alteration. It is concluded that the characteristic concentration of iron and hematite pigment in mudstones and shales in many ancient red beds, particularly in red beds that are associated with evaporites or aeolian sandstones, or both, reflects initial concentration of iron-bearing clay minerals and biotite in fine-grained sediments derived from desert source areas.

897. Walker, Theodore R., P.H. Ribbe and R.M. Honea GEOCHEMISTRY
OF HORNBLENDE ALTERATION IN PLIOCENE RED BEDS, BAJA
CALIFORNIA, MEXICO Geol. soc. amer., bull., v.78, no.8
pp. 1055-60, incl. illus., tables, graphs, August 1967,
6 ref. DLC QE1.G2

The chemical and mineralogical changes that have taken place during intrastratal alteration of hornblende in the arkosic red beds of probably Pliocene age in the Sonoran Desert of northeastern Baja California, have been determined by comparing the compositions of authigenic clay and the hornblende from which it was derived. The hornblende has altered to iron-rich montmorillonite, and thin sections show that this clay ultimately forms a hematite-stained matrix. The alteration involves loss of iron, alkalis, alkaline earths, and probably silica. The authigenic clay shows progressive decrease in iron content outward from the decomposing hornblende, indicating selective removal from the clay by intrastratal leaching. The authigenic clay is therefore an important source of iron for hematite pigment, particularly in the matrix of those red beds.

898. Wallen, C.C. ARIDITY DEFINITIONS AND THEIR APPLICABILITY
Geograf. ann., v.49A, no.2/4 pp. 367-84, incl. maps,
1967, 21 ref. DLC G25.G4

A review of various approaches to the problem of defining aridity is given and particular emphasis is placed on a critical analysis of different indices used for this purpose e.g., those of Koppen, de Martonne, Emberger, Gaussen, etc. For comparison the modern water balance concept as developed by Thornthwaite, Penman and Budyko is discussed. In the second part of the article an example of a practical study of aridity is given. This describes an investigation into the agroclimatology in the Near East undertaken by the author in cooperation with G. Perrin de Brichambault. Comparisons are finally made between the outcome of calculations of various indices for certain stations in the Near East for which the water balance conditions were established during the above investigation.

899. Wallen, C.C. ARID ZONE METEOROLOGY In: E.S. Hills (ed.)
Arid lands: a geographical appraisal. London, Methuen,
1966, pp. 31-51, 16 ref. DLC GB611.H5

Regrets the paucity of climatological data from arid areas. As a result, although we understand the general distribution of climatic types fairly well and the heat and water balance is outlined, we do lack precise data for most areas. Similarly microclimatic influences are here discussed in a rather general way -- most of this section is a discussion on the measurement and calculation of evaporation and evapotranspiration. The climatic effects of human "interference" include the problem of whether tree clearance increases or decreases soil moisture reserves, and the limited possibilities of cloud seeding.

900. Wallen, C.C. CLIMATOLOGY AND HYDROMETEOROLOGY WITH SPECIAL REGARD TO ARID LANDS UNESCO, Arid Zone Res., No. 18
pp. 53-81, incl. ref., 1962 DLC GB611.P3

Introductory remarks on climatological research in arid lands are followed by a description of the organization of research particularly under the UNESCO Arid Zone Program. Basic references to the literature on arid land climatology are given. Then information is given on the distribution and mapping of arid and semi-arid climates, observational problems in arid regions, the development of measurement instruments, the preparation of climatic data, research

in general meteorology and dynamic climatology and the study of climatic changes. Macroclimatological and microclimatological studies of the water balance are reviewed and future work and outstanding problems are summarized.

901. Warn, Fred SINKHOLE DEVELOPMENT IN THE IMPERIAL VALLEY
In: Engineering geology in Southern California. Glendale, Calif., Assoc. Eng. Geologists (Los Angeles Sec. F Spec. Pub.), pp. 144-45, incl. illus., 1966

Features usually associated with karst topography occur in Recent lake sediments in southwestern Imperial County, California. The surface is nearly flat and sediments consist of fine-grained clastic material deposited by freshwater Lake Cahuila, which disappeared about 400 years ago. Some evaporites are disseminated through the strata. Subterranean piping, during the occasional winter storms, is facilitated by water movements through burrows, mud-cracks, joints and bedding planes. Ground water occurs in sand and silty sand aquifers. These features create stability problems in highway construction. -- E.S.L.

902. Warren, Andrew A BIBLIOGRAPHY OF DESERT DUNES AND ASSOCIATED PHENOMENA In: Arid Lands in Perspective, ed. by Wm G. McGinnies and G.J. Goldman. Washington, American Assoc. for the Advancement of Science, 1969, pp. 77-99
DLC S613.A7

Bibliography covers the world-wide literature on sand dunes for over 90 years. Emphasis is on references to the Sahara, the U.S. and Poland. The material is arranged alphabetically within twenty year chronological divisions. Approximately 800 items are listed.

903. Watanabe, N. and R.L. DuBois SOME RESULTS OF AN ARCHAEO-MAGNETIC STUDY ON THE SECULAR VARIATION IN THE SOUTHWEST OF NORTH AMERICA Jour. geomag. geoelec., (Kyoto), v.17, no.3/4 pp. 395-97, 1965 DLC QC801.J63

Some preliminary data on secular variations of the geomagnetic field are given for 600 to 1500 A.D. as determined by archaeomagnetic methods. The inclination of the field has varied from a low of approximately 40° to a maximum of some 60° . Values of declination vary approximately from 10° east of true north to 15° west.

904. Weist, W.G., Jr. GEOHYDROLOGY OF THE DATELAND-HYDRA AREA, MARICOPA AND YUMA COUNTIES, ARIZONA Ariz. Land Dept. Water Resources Rept. 23, 46 pp., incl. illus., tables, 1965

Valley fill is the only water-bearing unit in the area. Bedrock is composed of granite, schist, and volcanic rocks, mostly lava. It is estimated that the first 100 feet of saturated material contains about 5,000,000 acre-feet of available ground water; in general, water levels in the area are slowly declining. Chemical analyses of 27 water samples from wells show that the water is sodium chloride type. It is acceptable for domestic and stock purposes, although fluoride content is high, and can be used for irrigation if proper practices are followed.

905. Wellman, H.W., and A.T. Wilson SALT WEATHERING, A NEGLECTED GEOLOGICAL EROSION AGENT IN COASTAL AND ARID ENVIRONMENTS Nature, v.205, no.4976 pp. 1097-98, 1965, 15 ref. DLC Q1.N2

Salt weathering of rocks occurs in sites protected from wind and rain where salts are concentrated, or where there is a rapid supply. Cyclic changes in humidity and/or temperature must include the crystallization point of at least one of the salts present. The large crystals in large pores in the rock grow most rapidly and exert great pressure on the walls, causing mechanical fracture. Salts are being concentrated in arid areas by the deposition of airborne salts particles. Cavernous weathering is common in the dry valley area of South Victoria Land, Antarctica, and within the holes a thin layer of "rock meal" mixed with salts is found. Salts are most abundant a few inches below the ground surface and here coarsely crystalline rocks are broken down, but no clay minerals are formed, showing that the process is different from normal chemical weathering. Tors in the most arid parts of New Zealand and Central Australia show cavernous weathering around their bases, with rock meal and salts within the holes, suggesting that their inselberg shape is due to salt erosion. Holes and caves are common in cliffs, both sea cliffs and those inland. In many examined by the authors, a thin film of rock meal was found covering the roofs and walls, and salt weathering was inferred. Salt weathering differs from other erosive processes by being most active on the underside of rock surfaces, and it therefore tends to steepen slopes.

906. Went, Frits W. THE ECOLOGY OF DESERT PLANTS Scient. amer.,
v.192, no.4 pp. 68-75, incl. illus., April 1955
DLC T1.S5

After discussing the plant species (bushes and annual plants) growing in Death Valley and discussing their manner of germination and growing, the author shows (and this is confirmed by laboratory experiments) that in the desert, as in the jungle -- where lack of space, light, food and water are the normal state of plants -- they share, and share alike, and if there is not enough for all of them to grow tall and strong, they all remain smaller, but do not wage war. Competition and selection of plants does occur during germination.

907. Went, F.W. ECOLOGY OF DESERT PLANTS, II: THE EFFECT OF RAIN AND TEMPERATURE ON GERMINATION AND GROWTH Ecology, v.30,
no.1 pp. 1-13, 1949 DLC QH540.E3

Topsoil from 4 different desert areas was collected, and spread thinly over washed sand in flats. When subjected to artificial rain and to a variety of temperatures, many seeds germinated. The heavy initial artificial rain caused 3-4 times as many seeds to germinate as germinated without the benefit of that rain. There were also marked differences in the rate of germination according to the temperature conditions and the source of soil. When subjected to 27°C day and 26°C night temperatures, a typical summer vegetation of annuals developed, comprising Bouteloua barbata, B. aristidoides, Pectis papposa, Amaranthus fimbriatus, Mollugo cerviana and Euphorbia micromera. None of the typical winter annuals grew. The latter were found in the flats kept during day at 18° and during night at 13° or 8°C. There none of the summer annuals grew, but winter annuals like Gilia aurea, Plantago spinulosa, Eriophyllum wallacei, Nemacladus longiflorus and Bromus rubens developed well. When seeds were sown so thickly that 5000 germinated per square meter, 56% survived and grew to flowering and fruiting plants.

908. Wertz, Jacques B. FLOOD CYCLE OF EPHEMERAL MOUNTAIN STREAMS IN THE SOUTHWESTERN UNITED STATES Assoc. Amer. geographers, ann., v.56, no.4 pp. 598-633, incl. illus., tables, ref., Dec. 1966 DLC G3.A7

The flood cycle of an arroyo in southwestern U.S. exhibit 3 separate stages: (1) the flood stage, often turbulent and violent, and impossible to study as it occurs; (2) the immediate after-flood stage, exhibiting conspicuous and interesting patterns, of which some may be observed and, (3) the dry stage, an indefinite period which lasts until the next flood, during which stage some detailed mechanisms of transport patterns may be observed. From this dry state, aided by schematic and fugitive impressions gained during the other 2 stages, systematic inferences may be drawn concerning the mechanisms involved in transport throughout the cycle. Schematic illustrations support the analysis and categorization of the several mechanisms and their transport-sedimentation activities. The flood stage thoroughly reworks the channels within a valley, rearranging the whole transport load of sediments. At the moment the flood begins to wane the heaviest elements of the whole load are dropped in a series of primary patterns arranged in steps up the longitudinal profile of the stream, dependent upon the nature of the channel, the volume of flow, and the velocity of the flood. The late waters of the after-flood stage readjust the attitudes of the channel, and resort the finer materials, perhaps systematically placing them on and between the steps of the profile. As the late waters continue to wane in volume the finest materials are finally resorted and arranged into the minor forms within the channel, to endure as sedimentation forms until the next flood occurs.

909. Wertz, Jacques B. ARROYO CUTTING AND CAPTURE: GEOLOGIC ACCIDENTS OCCURRING IN THE HABITUALLY DRY VALLEYS OF SOUTHWESTERN UNITED STATES (L'entaille et la capture d'arroyo: accidents geologiques servant aux vallees habituellement seches du sud-ouest des etats-unis.) Text in French. Rev. geomorph. dynamique, v.14, no.10-12 pp. 145-57, incl. illus., Oct./Dec. 1965, 19 ref. DLC G1.R443

Two geomorphological accidents, arroyo cutting and arroyo capture, are studied by the technique of thalweg contour lines. This technique brings out: (1) either the progress

or the lag in erosive activity occurring in channels, as compared to that affecting the intervening regions; (2) whether or not a channel may be subject to possible arroyo cutting, and (3) the emplacements where a capture has been performed in the past as against those where capture is still in process. It has been observed in the southwestern United States that faults often are responsible for the mechanism of capture.

910. Wertz, Jacques B. STRUCTURAL ELEMENTS OF ORE SEARCH IN THE BASIN AND RANGE PROVINCE, SOUTHEAST ARIZONA -- DOMES AND FRACTURE INTERSECTIONS Amer. inst. mining, metallurg. & petrol. engineers, soc. mining engineers, trans., v.241, no.3 pp. 276-91, incl. illus., 1968
DLC TN1.A5

Detailed structural studies in southeast Arizona have revealed: the local attitudes of individual fractures (with lateral and/or vertical displacements), the patterns exhibited by groups of fractures, and the trends and directions shown by fracture groups or zones on a regional scale. The results of the studies have been twofold: first, domes were locally determined from these fracture arrangements; and, second, fundamental breaks brought out the breadth of Texas lineament in southeast Arizona as well as major northwest-and-northeast-trending fracture zones. Coincidence of one or several domes with major intersections of fundamental breaks can be centers of important mineralization, as at Bisbee, Ajo, and Morenci.

911. Wertz, Jacques B. THE PHENOMENA OF EROSION AND DEPOSITION IN THE HABITUALLY DRY VALLEYS OF SOUTHWESTERN UNITED STATES (Les phenomenes d'erosion et de depot dans les vallees habituellement seches du sud-ouest des Etats-Unis.) Ann. geomorph., v.8 pp. 71-104, 1964
DLC G1.Z47

During storms in semi-arid portions of the Southwestern United States, floodwaters in arroyos create fundamental primary patterns mainly consisting of boulder fields alternating with level sand patches, the whole exhibiting definite stepping. Boulder fields, as parts of the emergent channel bottom after a flood, cannot be changed until the next flood. Sand patches, formed by filling of depressions and controlled in their distribution by trees, outcrops, bends, and confluences, are reworked by late waters with addition of a variety of secondary patterns. There are indications that the succession of these sand

patches may, within certain ideal conditions, exhibit a definite sequence, possibly logarithmic in nature.

Both primary and secondary patterns in arroyos help distinguish definite phases: a boulder phase near the mountains, where only boulders prevail, and a sand phase down valley, where only sands and gravels exist in the channel, with sometimes an intermediate or transitional phase. An important boundary, regional in nature, called the sand line, connects the upper edges of sand phases from one arroyo to the next, surrounding the mountains; it is an imaginary line, meaningless outside of the channel intercepts, that indicates where, in the arroyos, the change occurs from the turbulent and accelerating gushing of the waters into a decelerating pace toward the valley.

Boundaries between phases may be accurately predicted by a study of topographic maps, and by plotting gradients against lengths of channel on logarithmic charts. A similar procedure in the humid environment allows a forecasting of the occurrences of outcrops along rivers with fair accuracy.

912. White, Gilbert H. (ed.) THE FUTURE OF ARID LANDS Washington American Assoc. for the Advancement of Science, Pub. no. 43 1956, 451 pp. DLC GB665.A55

This volume includes the papers and recommendations presented at the International Arid Lands Meetings, New Mexico, April 26-May 4, 1955. Grouped within the following broad subject categories: the broad view; the variability and predictability of water supply; better uses of present resources; prospects for additional water sources; and better adaptation of plants and animals to arid conditions. Three of the papers are abstracted separately, (see nos. 283, 284, 285).

913. White, Natalie D., W.G. Matlock and H.C. Schwalen
AN APPRAISAL OF THE GROUNDWATER RESOURCES OF AVRA AND ALTAR VALLEYS, PIMA COUNTY, ARIZONA Ariz. Land Dept., Water Resources rept. 25, 66 pp., incl. illus., tables, 1966

The climate of the Avra and Altar Valleys is arid and almost no surface water is available for man's use. The only water supply in the area comes from the groundwater reservoir in alluvium that underlies the valleys; the water is of suitable chemical quality for most uses. Water from most wells along the central drainage is considered excellent to good for irrigation. Quality of water from most wells sampled is within the desirable limits set by the Public Health Service for drinking water.

914. Whittaker, R.H. VEGETATION OF THE SANTA CATALINA MOUNTAINS, ARIZONA: GRADIENT ANALYSIS OF THE SOUTH SLOPE Ecology, v.46, no.4 pp. 429-51, 1965, 80 ref.
DLC QH540.E3

Vegetation of the SW slope of the Santa Catalina Mountains of southeastern Arizona was sampled and transects prepared for 1000 foot (305m) elevation belts on granite and gneiss soils from the summit forests (2440-2750 m) to the base of the mountains (900 m). Transects also represented sub-alpine forests above 2750 m, and vegetation of the valley plain or bajada below the mountains, and samples were taken from volcanic soils below 900 m in the Tucson Mountains. Principle community-types from high elevation to low are noted, and include desert-grassland, Sonoran Desert or mountain slopes, bajada desert, and lower bajada desert. Physiognomic relations of communities are represented in charts of growth-form coverage in relation to elevation and topographic moisture gradients. Growth-form diversity increases from high-elevation forests strongly dominated by evergreen needle-leaf trees to desert of lower mountain slopes in which pinnate leguminous trees, spinose shrubs, suffrutescent semi-shrubs, and stem-succulents share dominance. The distribution of life-forms shows a strong geographical relationship. Flora of the Catalina Mountains is rich and community species diversities are high. Species diversities increase toward lower elevations; desert-grasslands and deserts of lower mountain slopes are among the richest communities in the United States. Floristic diversity is higher in continental than maritime climates, as indicated by comparison of species diversities and community differentiation along topographic moisture gradients in the Catalinas and in California mountains.

915. Wilcoxon, James A. THE RELATIONSHIP BETWEEN SAND RIPPLES AND WIND VELOCITY IN A DUNE AREA Compass, v.39, no.2 pp. 65-76, incl. illus., tables, Winter 1962, 8 ref.
DLC TN1.C793

A series of complex dunes in the south end of Death Valley (California) was selected for a study of the relationship between wind velocity and the size and shape of surface ripples. A portable anemometer was used to record the wind velocity on several occasions, and numerous measurements of the amplitude and wave length of ripples was made.

Samples were collected of the material from the ripple crests and troughs, and grain analyses were performed in the laboratory. With variations in wind velocity variations in the amplitude and wave length were noted. These variations prove to be dependent on grain size and location on the dune as well as velocity of the wind. Laboratory analysis of the material shows that the grain size is fairly uniform throughout and sorting is very good at all localities on the dunes.

916. Wilhelmy, H. CAVERNOUS ROCK SURFACES (TAFONI) IN SEMI-ARID AND ARID CLIMATES Pakistan geogr. rev., v.19 pp. 9-13, 1964 DLC DS376.P29

Tafoni, cavernous rock surfaces, are a special type of rock weathering in arid and semiarid climates. These hollows in rocks or tafoni are always covered by so-called "protecting barks," which are hard surface crusts (mostly iron hydroxyde) created by the evaporation of salt-bearing solutions. All samples of real hollow block formation will have in common their origin from either a periodic damp, frequently breezed coast-climate or they originate from a macroclimate aridity where long dry seasons with high temperatures cause strong evaporation as in deserts. Those areas are noted for their low annual precipitations which occur periodically during short intervals. Thus, the best conditions for tafoni formation are in the border areas of deserts, not in the central deserts where precipitation is too low.

917. Willden, Ronald and D.R. Mabey GIANT DESSICATION FISSURES ON THE ROCK AND SMOKE CREEK DESERTS, NEVADA Science, v. 133, no. 3461 pp. 1359-60, April 28, 1961, incl. illus., 5 ref. DLC Q1.S35

Open fissures, from 100 to several hundred feet apart, that have produced polygonal patterns on the Black Rock Desert, Nevada, are believed to be giant dessication cracks resulting from a secular trend toward aridity in the last few decades. Similar features on the Smoke Creek Desert probably have the same origin.

918. Williams, Thomas L. THE USE OF INSOLATION IN FORECASTING TEMPERATURE Amer. meteorol. soc., bull., v.34, no.6 pp. 245-49, June 1953, refs.
DLC QC851.A6

Accurate estimates of the albedo of clouds, the earth's surface and the atmosphere must be obtained if calculations of the radiation balance are to be used in objective forecasting of the daytime temperature. In this article a value of 0.14 has been used for a cloudless sky, and of 0.55 for an overcast sky -- following Fritz (1949). A table made by substituting these values in Angstrom's formula ($a=0.55n + 0.14(1-n)$), where 0.14 and 0.55 are the limiting values of the albedo for cloudiness of 0 and 1 respectively, is included. A value of 0.17 is used for albedo of earth's surface. These and other parameters were used for making forecasts for Las Vegas, Nevada and Phoenix, Arizona. Results are discussed.

919. Wilson, Eldred D. A RESUME OF THE GEOLOGY OF ARIZONA Ariz. Bur. Mines, bull 171, 140 pp., incl. illus., tables 336 ref., 1962 DLC QE85.W5

This report is designed to serve as a brief, general account of the geology and mineral deposits of Arizona. Although reflecting somewhat the author's own opinions, this account utilizes data from numerous sources. Details from published reports are omitted or generalized as far as possible, but extensive references are made to descriptions in the literature. Also, many unsolved problems are indicated. The geology and mineral deposits of Arizona are big, complex subjects. Although a large amount of information regarding them is available, much more remains to be learned through future detailed field work, laboratory investigations, progress in age determinations, and geophysics.

920. Wilson, Eldred D. and Richard T. Moore GEOLOGIC MAP OF MARICOPA COUNTY, ARIZONA Ariz., Bur. Mines, Univ. of Ariz. scale 1;375,000, 1957

Compared with the 1924 Geologic Map of Arizona, the County Geologic Maps contain much additional detail and more accurately delineate the geology because of a more accurate base map. A more comprehensive separation of rock units has been made, especially of the volcanic rocks and of the Precambrian crystalline rocks.

921. Woodard, Geoffrey Davidson THE CENOZOIC SUCCESSION OF THE WEST COLORADO DESERT, SAN DIEGO AND IMPERIAL COUNTIES, SOUTHERN CALIFORNIA Calif. Univ. Berkeley , PhD Thesis, 1966
Order from: University Microfilms, Ann Arbor, Mich., Order no. 66-15, 527, 216 pp., mi \$3.00, ph \$9.00

In a summary report of the regional geology of the southwestern Colorado Desert, T.W. Dibblee (1954) described six formations exposed along the western margin of the Imperial Valley. He referred the Split Mountain Formation, the Alverson andesite, the Fish Creek gypsum, and the Imperial formation to the Miocene series. A Pliocene age was assigned to the Palm Spring formation, and a Miocene-Pliocene age to the Canebrake conglomerate. The Neogene formations have been studied in a 150 square mile area that extends from the Vallecito and Fish Creek Mountains southeast to the Coyote Mountains. Reddish-brown granitic fanglomerate and arenite strata that have formerly been referred to as the basal member of the Split Mountain formation are defined as a new formation, the Arma conglomerate. In the type area in Split Mountain Gorge the formation is approximately 1,800 feet thick. The stratigraphic limits of the overlying Split Mountain formation are redefined to include four members. The lowermost and uppermost members are very coarse-grained sedimentary breccia and granitic fanglomerate beds. The Fish Creek gypsum rests conformably on the basal grey member and is separated from the upper member by a marine arenite and shale lens that is approximately 500 feet thick. The Imperial formation is separated by an erosional unconformity from the underlying Split Mountain formation. The Imperial beds grade upwards into terrestrial deposits of the Palm Spring formation. Both the Palm Spring and Imperial formations are laterally gradational into coarse granitic fanglomerate strata of the Canebrake formation. A new name, the Mesa conglomerate, is assigned to cobble fanglomerate and arenite strata that are preserved as erosional remnants unconformably overlying the deformed older Neogene strata. Within the area studied the Neogene deposits are found as a southwest dipping homocline that has been dissected by northeast-southeast trending left-lateral faults, wrinkled into broad, open west plunging folds, and subject to clockwise tortional displacement. Lateral offset along the San Andreas, San Jacinto, and Elsinore fault systems has been the principal agent controlling structural deformation.

922. Wopfner, H., and C.R. Twidale GEOMORPHOLOGICAL HISTORY OF THE LAKE EYRE BASIN In: J.N. Jennings and J.A. Mabbutt (eds.), Landform studies from Australia and New Guinea. Canberra, Australian National University Press, 1967, pp. 119-48, incl. illus., tables, 30 ref.
DLC GB381.J4

The driest (127 mm) and lowest (14 m below sea level) part of Australia; an area of 1 1/3 million km² drains to the lake. The stratigraphy and structure of the basin are described. During the Oligocene a duricrust formed across the whole surface of that time and is found on rocks of varied age. It is now dissected and caps prominent plateaus and cuestas. Another weathering profile of Pleistocene age is called gypsite. Younger deposits include old, cemented sand dunes, separated by a period of heavy vegetation from the modern sand dunes. The modern dunes occur in structural lows because it was there that suitable source material was available and partly because the even surfaces allow sand movement. The dunes are longitudinal and there is an inverse correlation between dune height and spacing. Playas are excavated by deflation within the structural depressions. The 1949-50 filling of Lake Eyre is discussed -- it is likely to occur every 50 years or so. Concludes with a history of the present landforms that summarizes the chronology of deposition, weathering and erosion.

923. Wright, Norman C. DOMESTICATED ANIMALS INHABITING DESERT AREAS In: Institute of Biology, Biology of deserts. London, The Institute, New York, Stechart Hafner, Inc., 1954, pp. 168-72 DLC GB611.I5 1954

Contains a discussion of the endocrine cycle of reproductive glands in desert animals and solar radiation and color patterns in desert animals. The various types of external color patterns of desert animals and their possible physiological significance, the internal black pigmentation in the peritoneum and pleura of desert reptiles and the penetration of solar radiation through the integuments of freshly killed insects and reptiles are discussed.

924. Wulf, Oliver Reynolds POSSIBLE EFFECT OF ATMOSPHERIC CIRCULATION IN THE DAILY VARIATION OF THE EARTH'S MAGNETIC FIELD, PART 2 Monthly weather rev., v.93, no.3 pp. 127-32, March 1965 DLC QC983.A1

Seasonal features that are not related in a simple way to solar declination occur in the daily variation of the horizontal intensity of the Earth's magnetic field at Tucson, as at Honolulu studied previously. They are studied here in quiet-day data averaged over 11 years. The nature of these features suggests that they may arise from the seasonal variation of the large scale air circulation in the lower ionosphere, and that they may offer the possibility of utilizing regular geomagnetic observations in meteorological research.

925. Yaalon, D.H. and E. Ganor THE CLIMATIC FACTOR OF WIND ERODIBILITY AND DUST BLOWING IN ISRAEL Israel jour. earth sci., v.15, no.1 pp. 27-32, incl. illus., table, 1966, 13 ref. DLC QE318.A3

A climatic index of wind erodibility based on wind velocity and on effective precipitation was found to be suitable for delimiting relative wind erosion conditions in various regions of Israel. A very high index of wind erodibility is obtained for the Negev. Some mountain areas in the Mediterranean climatic region belong to a higher erodibility class than the very low rated rest of the region. An intermediate to high index is obtained for the semi-arid regions.

926. Yarza De la Torre, Esperanza GASES AND VOLCANIC VAPORS OF BAJA CALIFORNIA (Los gases y vapores volcanicos de Baja California.) In: Union geograf. internac. conf. regional Latino-americana, Mexico, 1965, proc., vol. 2. Mexico D.F., Soc. Mex. Geograf. y Estadistica, pp. 246-55, incl. illus., 1966 DLC G56.I58

The Valle de Mexicali, consisting of hardened deposits of deltaic origin, is the site of three zones of hydrothermal springs and volcanic gases which may become important sources of geothermal energy. These zones coincide with a straight line through which is believed to run a fault of the San Andreas system; the Valle de Mexicali is compared with the Salton Sea region. The depth of alluvial soil in Mexicali is compared with the Salton Sea region. The depth of alluvial soil in Mexicali may be 2,500 m, most of it from the Colorado River basin and Grand Canyon. Two test wells indicate possible energy production of 20,000 and 35,000 KW; for the first of these, an analysis of the mixed vapor is given.

927. Zimmerman, Robert Charles PLANT ECOLOGY OF AN ARID BASIN OF ARIZONA Johns Hopkins Univ., PhD thesis, 1966, 199 pp.,
Order from: Univ. Microfilms, 300 N. Zeeb Rd., Ann Arbor, Mich. 48106. Order No. 69-2434; M \$3.00; X \$9.00

The area studies is located in the middle reach of the San Pedro Valley, southeastern Arizona. The climate is arid, and most streams have ephemeral flow regimen. Other regimens observed were flows that lasted more than 3 consecutive days but less than 2 consecutive months, and flows that lasted at least 2 consecutive months. In the summer, despite storm runoff, base flows disappear in many reaches. In December 1965, record rainfall caused runoff that lasted one week or longer in reaches that usually have ephemeral regimen. Variations in the vegetation are probably due mainly to differences in moisture regimens. Undissected slopes underlain by deep, friable loams support small trees and a grass cover, whereas dissected slopes underlain by cohesive deposits are mantled by stands of shrubs generally not floored by grasses. On valley floors, the vegetation varies with differences in drainage area, geology, and -- most conspicuously -- in surface flow regimen. Quality of water and width of the valley floor also seem to control the distribution of valley-floor vegetation. The species composition of valley-floor vegetation is apparently determined mainly at the germination-seedling stage of growth by the duration of surface flow. Far more species can germinate and survive the seedling stage along base flows than in streams in which only storm runoff occurs. The composition of the vegetation is probably also determined by differential survival of plants at the adult stage. Survival of plants is probably related mainly to surface flows. Most of the valley-floor vegetation studied seems to grow independently of regional water tables.

928. Zimmermann, Robert C. PLANT ECOLOGY OF AN ARID BASIN, TRES ALAMOS-REDINGTON AREA, SOUTHEASTERN ARIZONA US Geol. Survey, Prof. paper 485-D, pp. D1-D51, incl. illus., tables, 1969 DLC QE75.P9

The area comprises 750 sq mi of the middle reach of San Pedro Valley, a structural trough in the Basin and Range province; valley fill several miles wide and locally 1000 feet thick is flanked by mountains of Precambrian Mesozoic faulted bedrock. Average annual rainfall is about 12 inches. Drainage area, geology, and flow regimen are the most important controls of valley-floor vegetation; with uniform

geology and ephemeral flow, differentiation from upland vegetation increases with increasing drainage area. Sustained flows eliminate the effects of drainage area and geology (relative moisture retention of substrate). Optimum valley-floor width, fill thickness, and sustained base flow may support a closed-canopy forest; however, too-thick fill, with intermittent flow, supports only desert species. Most valley-floor vegetation grows independently of regional tables.

929. Alden, Peter FINDING THE BIRDS IN WESTERN MEXICO: A GUIDE TO THE STATES OF SONORA, SINALOA, AND NAYARIT Tucson, Univ. of Ariz. Press, 1969, 138 pp., incl. illus., maps, ref. DLC QL686.A42

According to the author this is the first guide-book to the birds of Western Mexico. Aimed primarily at the amateur rather than the professional ornithologist, the book, birds, are listed in the order established by the 5th ed. of the American Ornithological Union's Checklist of North American Birds, (1957), and are grouped in the text according to locality.

930. Anderson, C.A. THE 1940 E. W. SCRIPPS CRUISE TO GULF OF CALIFORNIA: PART I, GEOLOGY OF ISLANDS AND NEIGHBORING LAND AREAS Geol. soc. Amer., Memoir 43, pp. 1-52, 1950

Contains observations made on the 1940 E.W. Scripps cruise to lower California and the Gulf of California. Contains an excellent geologic map of lower California and of Sonora and northern Sinaloa. A discussion of the geology of the eastern margin of the Gulf which includes the geology (generally) of Sonora, Guaymas area, Tiburon Island, and Gulf Islands is given.

931. Antunez, E. Francisco, and others RESULT OF GEOLOGICAL AND MINING EXPLORATIONS MADE BY THE NATIONAL NUCLEAR ENERGY COMMISSION IN THE REPUBLIC OF MEXICO, WITH REFERENCE TO DEPOSITS OF RADIOACTIVE MATERIALS (Resultado de las exploraciones geologicas-minerales realizadas por la comision nacional de energia nuclear en la republica Mexicana, en lo referente y yacimientos de minerales radio-activos.) Test in Spanish with English abstract. In: Inter-American symposium on the peaceful applications of nuclear energy, 4th, Mexico City, 1962, proceedings. Vol. 1, Wash. Pan Amer. Union, Gen. Secretariat, Organ. of Amer. States, 1962, pp. 257-75 DLC QC770.I494 1962

Since 1957, the National Nuclear Energy Commission has

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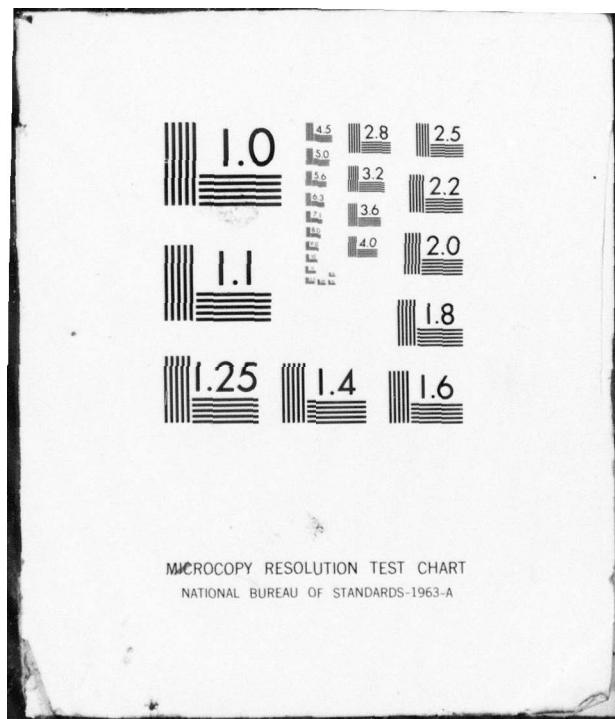
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been carrying on a broad and continuing program of geological and mining explorations in search of atomic materials. To date, an area of 11,000 km² in 14 states of the country has been covered. Of these states, Sonora, Chihuahua, and Durango are the ones that up to now seem to have the most favorable geological conditions for the presence of uraniumiferous deposits. The exploration work done in various areas of these states makes it seem certain that we now have radioactive mineral reserves conservatively estimated as follows: 200,000 tones of Cu-pro-uraniferous minerals, with an average U₃O₈ content of 0.15%, in the "San Antonio del Cobre" deposit in the municipality of Soyopa, Sonora state; 12,000 tons of primary U minerals (pitchblende) with an average U₃O₈ content of 0.2%, in the Granaditas deposit, located in the municipality of Arizpe, Sonora; 300,000 tons of secondary minerals (carotite and autunite), with an average U₃O₈ content of 0.1%, in the "La Preciosa" deposit in Nazas, Durango state; 30,000 tons of mineral with tyuyamunite, in the deposit, contained in limestone, of the Sierra de Gomez, with an average U₃O₈ content of 0.4%. In addition, in other areas of the states of Sonora, Durango, Chihuahua, Puebla, and Oaxaca, a total of 64,000 tons of radioactive minerals, with an over-all average U₃O₈ content of 0.2%, have been measured. Altogether, the Commission's reserves of radioactive minerals at present amount to 606,000 tons, with an average U₃O₈ content of 0.1438%.

932. Balls, Edward K. EARLY USES OF CALIFORNIA PLANTS Berkeley, Univ. of California Press, Calif. Natural History Guides: 10, 1962, 103 pp., incl. illus., 24 ref.
DLC QK149.B25

In the presentation of the material selected, it was held desirable to include, in a single statement, all uses to which a plant was put. This poses a problem as to which category a plant might belong. Plants were therefore placed under the heading in which their most important use falls, as in the case of yuccas where fibres are the primary product, but food, soap and dyes are also obtained. In all cases, plants are referred to by their common name; an alphabetically checklist of common names followed by their scientific names is provided at the end of the book.

933. Geukens, F. GEOLOGY OF THE ARABIAN PENINSULA -- YEMEN
Geol. Sur. Prof. paper 560-B, 22 pp., 1966

After the leveling of the Precambrian metamorphic basement after the end of the Paleozoic, sandy formations of continental facies were deposited mainly in the northern part of Yemen. During the Mesozoic, sandy conglomerates were deposited in the area of subsidence. The last marine progression, of Paleocene age, involved the central part of the country.

934. Willis, R.P. GEOLOGY OF THE ARABIAN PENINSULA -- BAHRAIN
Geol. Sur. Prof. paper 560-E, 4 pp., 1967

The Shiekdom of Bahrain is a group of islands in the Persian Gulf between the Qatar Peninsula and Saudi Arabia. The discovery well was completed as a producer from the middle Cretaceous in June 1932. The principal outcropping rocks on Bahrain, the main island are of Eocene age, with Miocene and younger rocks on the periphery. The anti-clinal structure is clearly discernible in the rimrock that encircles the central part of Bahrain Island.

935. Weiner, J.S. HUMAN ADAPTABILITY TO HOT CONDITIONS OF DESERTS
In: Institute of Biology, The biology of deserts. N.Y.,
Stechart-Hafner, Inc., 1954, pp. 139-99
DLC GB611.I5 1954

The author discusses the heat load imposed by the desert conditions upon the human body, the ethnological characteristics of the various hot deserts, the evaluation of the discomfort of desert conditions in terms of effective temperature scale, an estimation of the working capacity of man in the desert on the basis of maximum cooling capacity, physiological adjustments to desert heat including salt intake, sweating and acclimatization failure, in physiological adaptation with circulatory failure, dehydration, sweat gland fatigue, etc., and the problem of desert and "racial selection."

936. Butterfield, Floyd S. THERMAL SURVEY FOR GROUND WATER AT THE
PROPOSED TANK ARMAMENT RANGE, YOUM PROVING GROUND, ARIZONA
Dept. of the Army, Sacramento District, Corps of Engineers
DACA05-79-P-0156

Reconnaissance of a survey to evaluate the hydrologic condition
in the YPG area and the potential for development of the
ground water resource. Conclusions and results are presented
along with a map of the ground temperatures.

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ATTN: DRCPM-MEP (Mobile Electric Power)
7500 Backlick Road
Springfield, VA 22150

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Commander
US Army Tropic Test Center
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